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ABSTRACT

This five-section symposium report includes 22 papers assessing the state-of-the-art in occupational research. Section 1, Occupational Analysis, Structure, and Methods, contains four papers that discuss: the Air Force Occupational Research project, methodologies in job analysis, evaluation, structures and requirements, career development, personnel utilization, and job satisfaction; task statements preparation, administration, and interpretation to clarify skills and relate them to functional job requirements; clusters of work tasks for the military; and the Position Analysis questionnaire attempting to qualify job descriptions and data. The six papers in section 2, Career Development, examine: congruence theory, theories of decision-making during career development, theoretical models, personal value systems of managers and administrators, and career motivation in the Navy. The five papers in section 3, Organizational Effectiveness, focus on research methodologies in monitoring and measuring organizational effectiveness. In section 4, Motivation and Work, the three papers present the overview, current perspectives, and a suggested approach for a research model for measuring motivation. In section 5, Measurement and Prediction, the four papers discuss: biological psychology and human performance using brain wave research; historical research analysis procedures, personnel selection and placement decisions by computerized ability testing, and measurement of intellectual competence. (JB)

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SYMPOSIUM PROCEEDINGS
OCCUPATIONAL RESEARCH AND THE NAVY - PROSPECTUS 1980

Earl I. Jones, Director

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This report includes 22 papers assessing the state-of-the-art in Occupational Research presented in a symposium on 10-12 July 1973. Fields covered include: (1) Occupational Analysis, Structure and Methods, (2) Career Development, (3) Organizational Effectiveness, (4) Motivation to Work and (5) Measurement and Prediction.

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PREFACE

The Navy Personnel Research and Development Center has established an Independent Research and Development Program. This program includes the function of planning and coordinating "state-of-the-art" symposia in areas critical to the Center's mission. The purposes of such symposia are: (1) to assess the potential of areas of science and technology for solving relevant problems, (2) to provide a basis for advancing science and technology and for planning future R&D, (3) to engage in meaningful technological forecasting, and (4) to enhance inter and intra disciplinary dialogues among members of the Research and Development Community.

Occupational Research was chosen as the first area for a symposium because of its central significance, its prospects as a prototype symposium and its suitability with respect to the purposes cited above.

In planning the symposium, problems divided quite naturally into logistics and content. A contract with Jakus Associates solved the logistics problem. Through this contract arrangements were made for carrying out the symposium and for providing for most of the typing, editing, proofing and formatting necessary in publishing the symposium proceedings.

The leadership and cooperation of Dr. Ernest J. McCormick, Purdue University; Dr. Edwin A. Fleishman, American Institutes for Research; Dr. Marvin D. Dunnette, University of Minnesota; Dr. Robert Penn, San Diego State University; and Dr. Bernard Rimland, Navy Personnel Research and Development Center were obtained to help in the planning and organization of the symposium, in arranging for excellent sets of presentations by extremely well qualified people in five fundamental areas or topics of Occupational Research, and to serve as chairmen of the topic sessions.

Each of the five topic sessions contributed to the symposium goals.

Dr. McCormick's session on Occupational Analysis, Structure and Methods is a convincing display of the progress occurring since Shartle's milestone book in 1946. The wide application of occupational analysis is best portrayed by the remarkable expanse and continuity of Air Force work under Dr. Raymond Christal with the marked power of computer support through the use of CODAP. The fine-grained development and application of Functional Job Analysis by Dr. Sidney Fine explicates issues of language use, roles of organizations and individuals, and levels of analysis. The concept of modules developed and described by Drs. Stephenson, Cory and Johnson, provides a mechanism for organizing areas of task commonality which allows real diversity in the use of modules as building blocks. The Position Analysis Questionnaire (PAQ) developed by Dr. McCormick not only contributes a standardized, well defined approach to job/position description, but through the use of factor analysis defines dimensions and structure of positions in a unique, useful and stable manner. The utility to the military service of this area is well summarized in Dr. Christal's paper in which very pertinent recommendations for Navy use are pinpointed.

Dr. Fleishman's session on Career Development provides a rich and mixed bill of fare. The Walsh and Korman papers present and evaluate basic theoretical concepts. The Tiedeman paper provides an amazing exercise in conceptual analysis. The England and Glickman papers tap earthy, empirical, real world matters where Glickman, in particular, deals directly with Navy problems in a Navy context. The problems of career Development are fully treated through discussion of Holland's theory and the concept of congruence, analysis and description of systematic decision making in career development, modeling career growth and decline, discussion of managers' value systems and career motivation. Each of these topics has implications for useful research and application in the Navy with respect to career planning, development and evaluation.

Dr. Dunnette's session on Organizational Effectiveness continues the emphasis on quality. This area exemplifies markedly the consistently recognized difficulties of the social sciences with respect to experimental design and control, applicable models, and development of principles. The challenge is great. Beginning with the Campbell paper, the issues are clear and the difficulties explicated. Thorough reading of the Campbell paper will show that it is an excellent review and provides a valuable backdrop against which to view the other papers in this field. Its range across the sociological origins of this area through the turning point provided by the 1957 Georgopoulous and Tannenbaum study, thence into the "golden" period of the 60's paints a picture of effort dedicated toward empiricism and quantification, but characterized by an undercurrent of despair. The salient forecast concerning the endangered species, the contrast with organizational development, and the penetrating analysis of and concern with criterion problems typify Campbell's paper. Indeed, these features make the Campbell paper a classic which serves to enhance the already fine papers prepared by Milkovich, Franklin, Payne and Arima.

Dr. Penn's session on Motivation and Work adds outstandingly another salient area of Occupational Research. Almost any reference in the long history of motivation as a central concept in behavioral science makes clear two things: The extreme practical utility and value inherent in understanding and controlling motivation and the extreme difficulty involved in achieving this ideal goal. Penn's paper, like Campbell's in the preceeding session, is a landmark review and an excellent background for the Graham and Zedeck papers. Penn's paper centers around the nine questions first raised by Gardner Lindzey in 1958 and the description and assessment of mechanical process theories and substantive content theories. Graham follows with insightful concern about the validity of current theories of motivation and difficulties of and suggestions for conducting research. Zedeck's sphere is normative vs. ipsative models of measurement and new approaches in applying regression analysis to motivational research. Thus Zedeck's paper suitably concludes this session while furnishing a bridge to the next.

The final symposium session, Measurement and Prediction was ably organized by Dr. Bernard Rimland. The session begins with a most interesting and forward looking paper by Rimland. Well aware of the "steady-state" of average validity coefficients achieved by classical prediction techniques, Rimland describes the possible potency of Biological Approaches. Moonan's paper on Vistas of Analysis breaks new ground in an area of long-standing concern in applied statistics and measurement--the problem of dealing with qualitative or categorical variables. Moonan's developments, together with able support in developing computer programs for putting his methods to work, hold high promise for both Navy and general application. Again, in the McBride and Weiss paper new ground is broken in a relatively new field--Ability Testing by Computer. Computers are pervading the universe in ways which sometimes make difficult the assessment of gains and losses. However, testing by computer is here to stay, first in a conceptual, next in a pragmatic way. Advantages, strategies, models, difficulties, and categories of adaptive testing are well articulated in the McBride and Weiss paper providing a sure bet for technological forecasting and future research and application in personnel testing. As anchor man, Bentler attacks a problem of both technical and social significance. The political and civil necessities for non-cognitive testing are presented along with a most lucid account of ten major problems of historical, current and future concern. Bentler's discussion of these problems is an excellent finale for the symposium because his guidelines in an important area are so well presented. Adventitiously, but not surprisingly, an impressive number of the speakers based their papers on work supported by the Office of Naval Research. Three of the five session chairmen also hold contracts with ONR. Thus the symposium provides still another indication of ONR's role in the field of Occupational Research.

Altogether more than 150 people attended one or more of the various sessions of the symposium. Their voluntary reactions in the form of letters, telephone calls and direct comment demonstrate that the symposium was a success. This success is directly creditable to the session chairmen and the subtopic speakers all listed in the section titled "Participants". To all of these people and their affiliations, to the Office of Naval Research, and to Jakus Associates the Navy Personnel Research and Development Center expresses gratitude.

EARL I. JONES
Director

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SECTION I

OCCUPATIONAL ANALYSIS, STRUCTURE AND METHODS

Dr. Ernest J. McCormick, Chairman

The United States Air Force Occupational Research Project	Dr. Raymond E. Christal
Functional Job Analysis	Dr. Sidney A. Fine
The Concept of Modules in Military Jobs	Dr. Robert W. Stephenson Dr. Bertha H. Cory Dr. Cecil D. Johnson
Position Analysis Questionnaire (PAQ)	Dr. Ernest J. McCormick

THE UNITED STATES AIR FORCE OCCUPATIONAL RESEARCH PROJECT

Raymond E. Christal

INTRODUCTION

The United States Air Force Occupational Research Project was established in 1958, some 15 years ago, and has been supported continuously since that time. The project objectives call for the development of methodologies in a number of areas, including the following:

- Job Analysis (Collection, analyses, and reporting of information defining work performed by personnel)
- Job Evaluation (for grade, pay and skill levels)
- Job Structures (including job engineering, work organization, and occupational classification)
- Job Requirements (for aptitude, training experience, etc.)
- Career Development
- Personnel Utilization
- Job Satisfaction (in particular, as it relates to retention)

Obviously, I cannot discuss even the highlights of a 15-year program in the limited time we have today. I will restrict my comments to some of the techniques the Air Force has developed for collecting, analyzing, and reporting occupational data and a few recently completed or ongoing studies which may be of interest to you. I will draw freely from previously published papers, my own memory, and data from studies yet to be published.

DEVELOPMENT OF JOB SURVEY TECHNIQUES[1]

Reasons for selecting the Job Inventory Approach

In the Air Force we chose the job inventory as the only feasible approach for collecting work-task information from large numbers of workers. There were a number of reasons for this decision: First, the technique is economical. Data can be collected from thousands of people throughout the Service for less than it would cost to collect data on a few people using professional job analysts. Second, the information obtained using job inventories is quantifiable. That is, the number of people performing any particular task can actually be counted and their characteristics described. Note that data collected by traditional job analysis are not quantifiable. No two analysts will describe a job in exactly the same terms. Third, the fact that information collected with job inventories is quantifiable means it can be stored, manipulated, analyzed, and reported by computer. Finally, the fact that information is quantifiable also means it can be validated and checked for stability using conventional statistical techniques.

A job inventory contains two sections: (1) Questions to be answered by a worker about his job and himself - questions relating to name, identification number, previous education, time-on-the-job, tools used, job location, equipment worked on, training schools, pay grade, job attitudes, and so on. Any item can be included in the background information section of an inventory which may help answer questions posed by managers of the personnel system. (2) A list of the significant tasks that may be performed by workers in the occupational area to be surveyed. That is, tasks being performed by apprentices, journey-men, first-line supervisors, and superintendents in one or more occupations, such as supply specialist or engine mechanic. If the task list is properly constructed, every worker in the occupation should be able to define his job adequately in terms of a subset of tasks in the inventory.

Construction of Job Inventories

Ordinarily, an initial task list is constructed from available printed materials. In the Air Force program, this list is first reviewed by 5 to 10 senior supervisors in an interview situation who correct technical wording and add additional tasks which are known to be performed by workers in their occupational area. This expanded task list is then sent by mail for a field review by supervisors at various locations throughout the Air Force. According to the complexity of the occupational area, these mail reviews may be obtained from as few as 25 to as many as 100 supervisors. At some time during the construction phase, the task list is also reviewed by technical school instructors. The final task list is arrived at through this iterative process.

There is some variation in construction techniques used by the military services. For example, the Marine Corps does not use a mail review procedure, but makes extensive use of personal interviews at many locations. The Army makes use of technical school instructors as inventory constructors. The Coast Guard, which also constructs and administers inventories, essentially follows the Air Force techniques.

Air Force experiences have led to two conclusions. First, individuals who are untrained in writing task statements do a poor job of building job inventories for their own occupational area. It is better to keep the pencil in the hands of a trained inventory constructor and let supervisors in the field of interest serve only as technical advisors. Second, if inventories are constructed by technical school instructors, care must be taken to see that they are not biased through inclusion of only those tasks which have relevance for training. For example, a task concerned with sweeping the floor has little relevance for training, but may have a great deal of relevance for managers interested in job satisfaction, job evaluation, or job re-engineering. It is best to have inventories constructed by individuals who have a broad perspective of all future applications of occupational data.

How many tasks should be included in an inventory? This has been a major problem faced by every organization entering the job survey business. Most agencies begin with inventories which are too short. Ten years ago, the Air Force inventories were averaging 250 to 350 tasks. Today, they are averaging around 500 tasks or more. Yet the Air Force has relatively narrow occupational career ladders - approximately 230 of them. Inventories constructed by smaller military services tend to be much longer. In the Australian Air Force, for example, job inventories sometimes contain more than 1,000 tasks. Such lengthy instruments may appear to be a problem, but they are not as difficult to manage as one might think. If task statements are organized under duty headings, and if the worker has to mark only those tasks which he actually performs, then even a long inventory can be filled out in a reasonable period of time. Furthermore, it has been a common finding that detailed task lists lead to firmer conclusions concerning such things as the establishment of training requirements and the evaluation of occupational categories.

How many background questions are normally included in an inventory? It is extremely important to be able to define any subgroup of people which may be of interest to management. If a manager wants to know the tasks being performed by aircraft mechanics working on a particular aircraft at particular locations who have taken certain training and who have been on the job less than one year, this can be obtained only if background variables have been included which define the relevant characteristics. For reasons to be discussed later, the single most important background variable for inclusion in a job inventory is worker identification.

How many workers should be sampled in an occupational area? The more the better. If one were interested only in the occupation as a whole, then perhaps a small sample would suffice. But experience has shown that managers are often interested in definable groups such as females, individuals at a particular grade or salary level, workers maintaining a particular type of equipment, and so on. Unless one has collected information from a large sample, there will be insufficient numbers of cases to make reliable inferences about such groups of interest. Large samples are also needed to perform meaningful job-typing analyses--especially if the occupational area is complex.

The Comprehensive Occupational Data Analysis Programs package (CODAP) is designed to handle data on samples of 20,000 workers, except for programs associated with job-typing analyses, which will now accept data on 7,000 workers. The Air Force has attempted to obtain 100% samples in occupational areas containing 2,000 or fewer workers. In larger occupational areas, we have attempted to obtain data on not fewer than 2,000 workers. If the occupational area is known to contain a variety of job types, we may obtain data on 5,000 or more workers.

What about the costs of data collection and analysis? The cost of developing an inventory and of analyzing the results is essentially the same, regardless of the length of the inventory or the number of persons to whom it is given. It can cost between one and two hours of work time for each worker included in the survey, which is of consequence. However, in the Air Force, inventories are administered so as not to interfere with accomplishment of primary mission, so the costs and value are weighed against the costs and value of other nondirect mission programs which consume time, such as commander's calls, formations, physical training, and so on.

One cost which can be substantial is that of getting the response information onto magnetic tape, ready for computer input. All military services are, or soon will be, collecting data on optical scanning sheets. To the extent that data are processed by scanner, the cost of preparing data for computer input is reasonable.

No specific answer about costs has been given but costs are modest compared with the savings which can be generated from appropriate applications of occupational data. This topic is directly addressed later.

Administration of Job Inventories

The problem of inventory administration. In the Air Force, inventories are sent in bulk to Consolidated Base Personnel Offices throughout the world. Instructions specify that workers meeting certain specifications will be called into testing rooms to fill out inventory forms under controlled conditions. In the Marine Corps, the task analysis unit sends out teams to administer inventories on site at various locations. They report excellent results. However, this approach is feasible only if a Service or organization has a limited number of bases or installations.

Instructions for filling out an inventory are relatively simple. The worker completes the background section, reads the task list and checks those tasks which he performs as part of his normal job, writes in any significant tasks which he performs which were not in the task list, and then rates the tasks he has checked using a relative time-spent scale.

The write-in feature serves several useful purposes, but primarily it provides an indication of the quality of the task list. If a large number of significant new tasks are uncovered by the write-in feature, the administration of a supplementary survey may be required. Otherwise, the uncovered tasks are used to guide interpretation of results and are saved for inclusion in the next form of the survey instrument.

Quality of Job Inventory Data

Can workers be trusted to be thorough and completely honest when they fill out job inventories? Studies have been conducted concerning this question. The answer is definitely "Yes," at least as far as workers in the Air Force are concerned. When a worker fills out an inventory on two occasions, he gives essentially the same information both times. Split-half reliabilities for information such as the percent of workers performing various tasks run from .95 to .99. Supervisors agree with the information provided by their subordinates. Information collected with daily work records is consistent with information collected with inventories. Workers do not inflate their job descriptions in terms of the number and difficulty levels of tasks they report. The work tasks reported by individuals are consistent with the information they provide in the background section concerning tools utilized and equipment worked on.

Many such studies have been conducted and reported. However, the experiences which have convinced us beyond any doubt that we are getting high-quality information are less objective and have never been fully documented. For example, during the first several years we obtained the telephone number of every worker who filled out an inventory. When we received what we thought might be false information, we called the worker and talked with him about his job. Over and over again, we found the worker was trying to be honest. Most often, the worker had been assigned a peculiar job because of local circumstances. In some instances, our inventory contained bad task statements which did not allow the worker to reflect his true job. We did find that, while being honest, many workers will give themselves the benefit of the doubt. For example, a worker might claim to perform a task when, in fact, he only performs part of that task. This is one of the problems with task statements which are too broad, and it helps to explain why our inventories now have over 500 task statements.

Another factor which helps us to feel confident about our data is that we have published analysis results from over 200,000 cases in approximately 150 occupational areas, and these results have never been proved wrong by managers, workers, or trainers in those occupational areas. There have been occasions when we were worried. In one instance, we found that very few workers were performing a large set of tasks which constituted approximately 25% of a training course. The managers of the occupational area were so unbelieving that they did an independent survey interviewing every worker in the occupational area to see if, in fact, he performed any of the tasks in question. The results of this interview-survey were, for all practical purposes, identical with those obtained from the inventory administration. Such experiences have convinced the researchers, and also Air Force management that job inventories yield good data.

Our latest experience with the power of job inventories to give quality data came when we surveyed approximately 5,000 civilian workers in one occupational area. We were particularly worried in this instance, since civilian pay is directly tied to job content. Under this circumstance, a worker might feel he has something to gain by being dishonest, or something to lose by being honest. Analyses indicate that, even under this condition, workers are honest.

We feel there are two factors operating which cause us to get honest reports from workers, and that these factors are interacting. *First*, the worker is asked to provide his name and social security number in the inventory, and *second*, the information provided is objectively verifiable. It is unlikely that a worker will claim to perform a task when everyone around him knows that he does not perform that task. Similarly, it is unlikely that he will fail to report a task which everyone around him knows he performs.

Importance of Worker Identification

There are several reasons why it is strongly recommended that name and identification information be obtained from workers who fill out job inventories. *First*, many studies demonstrate that high-quality data can be obtained *when workers provide their names*. If identification information is not obtained, one cannot even conduct a study to validate his data. *Second*, collecting identification information enables one to follow-up workers and trace their career development over time. *Third*, identification information can be used to match with other personnel files to pick up additional data on workers, such as their aptitude scores and work history. *Finally*, identification information enables one to produce a description of the work being performed by a particular person, or to locate by name all individuals who are performing a particular task or set of tasks.

Use of the "Relative Time Spent" Rating Scale

Consider the rating scale for a few minutes, because this is an important topic. Research indicated that many workers do not have a clear idea of the exact percentage of their time devoted to each task performed. On the other hand, they can state with confidence that they spend more time on one task than on another. This led to the development of a "relative time-spent" scale, by which workers report the amount of work time spent on each task relative to the amount of time spent on other tasks. We use a 7-point relative time-spent scale. If an individual does not perform a task, he leaves it blank. If he does perform it, he rates it from a level "1," which means that he spends an extremely small amount of time on it compared to the amount of time he spends on other tasks in his job, to a level "7," which means that he spends an extremely large amount of time on it compared with the amount of time he spends on other tasks in his job. These relative time-spent ratings are converted into estimated *percent time values*. The first question often asked by individuals reviewing this procedure is "Why percent time? Why not use some other factor such as frequency of performance?"

It is beyond the scope of this paper to discuss all of the factors favoring use of percent time-spent estimates, but several are sufficiently important to warrant your consideration. First, there are certain statistical characteristics which make this approach extremely useful. It has a clearly defined range with a base value of "0." For the individual case, the values indicate the percentage of his work time spent on each task, and the sum of these values across all tasks in the inventory is 100%. In a like manner, the average values for any group of workers indicate the percentage of group time spent on each task, with the sum of these values also equalling 100%. Percent time values provide a convenient method for computing the overlap of two individual jobs with each other, of an individual job with a group job description, or of one group job description with another group job description. Results from numerous studies have indicated that matrices reflecting overlapping time among individual job descriptions, when analyzed by the CODAP grouping program, can yield a precise definition of the types of jobs existing in an occupational area. Finally, having the percentage of time spent on tasks available makes it possible to compute the time spent by individuals or groups on particular types of work. For example, a manager may wish to know how much time is being spent by a group of mechanics on preventive maintenance. This can be very quickly computed by the CODAP system. It should be noted that none of the above characteristics apply to a scale such as "frequency of performance." How could one possibly summarize the level of activity across a series of tasks in terms of frequency, when some of the tasks are performed frequently, while other tasks within the subset are performed infrequently? Use of the relative time-spent scale as the primary rating factor in occupational surveys is strongly recommended. The obtained values should be transformed into percent time-spent estimates. This is a requirement for the CODAP system, and makes possible many types of analyses which cannot be accomplished using frequency of performance data.

THE CODAP ANALYSIS SYSTEM

CODAP is the analysis system used not only by the Air Force, but also by other military services. There is simply no way in a brief amount of time to communicate the power of this system. We have been working on it continuously for over 13 years, and the program listings now run about 1,400 pages in length. It represents an investment of hundreds of thousands of dollars, and thousands of in-service man hours. Yet, it is without question the most important product of the Air Force Occupational Research Project.

The concept behind CODAP is to provide ways for analyzing, organizing, and reporting occupational information to answer as many management questions as possible. CODAP currently contains approximately 40 general purpose programs, and several new ones are under development. All of these programs are interactive and highly efficient. A few programs which are used frequently (See the Appendix for a description of selected CODAP programs and example CODAP outputs) are mentioned here.

Example CODAP Programs

One program produces a consolidated description of the work performed by any specified group of individuals. Such a description can be produced for workers at a particular base; or for those who have been in their jobs less than one year; or those who claim their talents are not being utilized; or those who work on a particular type of equipment--indeed, for any group of workers which can be defined in terms of information in the background section of the job inventory. A consolidated job description indicates the percent of group members performing each task, the average percent of work time spent on the task by those who perform it, and the percent of group time spent on each task. A CODAP program prints the task statements and associated computed values, arranged in terms of percent members performing, or in terms of group time-spent values. A consolidated description of the work performed by individuals during their first year or two on the job is particularly useful in validating or designing the curricula for entry-level vocational training.

Normally, when analyzing an occupation a series of job descriptions for groups at various experience levels is produced. That is, consolidated descriptions are computed for individuals who have been in the occupation for less than one year; from one to two years; from two to four years; four to eight years; and so on. Then the CODAP system is used to gather this information into a table which indicates the percent of individuals at each experience level that perform each task in the inventory. In this way, we find when tasks tend to be assigned, and when training should be given in order to be timely.

Another CODAP program enables managers to study the differences in work being performed by any two specified groups of individuals. For example, one might wish to know the differences in work performed by individuals at one grade level and those at another grade level; or in the work performed by individuals working on two types of equipment. The CODAP system analyzes the two defined groups and prints a report summarizing the major differences in work performed.

Perhaps the most powerful CODAP program is one which identifies and describes all the types of jobs which exist in an occupational area. Beginning with 2,000 individual job descriptions, this program will compute a 4,000,000-element input matrix reflecting the similarity of each job with every other job. Then it proceeds to group similar jobs into clusters and prints out a description of work performed by individuals in each cluster. The program is iterative and may evaluate well over a billion alternative solutions in arriving at the best definition of job types and clusters in a particular occupation. Still another CODAP program can be used to determine the characteristics and locations of individuals working in each job type and cluster. The results of job typing analyses are extremely valuable in identifying changes needed in defining occupational categories in an organization or military service.

Other CODAP programs can be used to compute job descriptions for individuals, or for each individual in a specified group, or to compute the amount of work time each worker spends on a given set of tasks. Using factor ratings in conjunction with task data, CODAP can be used to compute the difficulty level or the grade requirement for each job. Programs are available within the CODAP which will produce two-way frequency distributions between background variables; compute the difficulty level of each task; compute intercorrelations among background variables; determine the reliability of task factor ratings; compute the average grade level or the average experience level of workers performing each task; compute regression equations; print task lists, or print a dictionary of background variables. The CODAP system is also a general occupational information retrieval system. All reports, descriptions, and analysis results computed by CODAP are stored and identified. Any subset of descriptions or reports can be extracted, ordered, and printed. CODAP even numbers the pages in an extracted report and automatically prints a table of contents. In general, there is a CODAP program available to organize and analyze occupational data to answer any question asked by managers of a personnel system. If we find that there is another type of analysis which would provide information on a question posed by management, then we immediately write a new program which will perform the necessary computations. This is one reason why all military services in the United States either are, or will shortly be, using the CODAP system for their occupational analyses.

Adoption of Job Survey Technology by Various Agencies

The Air Force did research on various techniques from 1958 until 1967. During this period, we collected experimental data from over 100,000 cases and developed most of the programs in the CODAP system. Although cost savings data were not accumulated during this time period, occupational data led to numerous changes in training programs and occupational structures. In late 1967 the Air Force established an operational unit with 15 persons who devoted full time to the construction, administration, and analysis of occupational survey data. Its mission called for the completion of 15 surveys per year. In 1969, the staff of this organization was increased to 28, and the mission increased to 24 surveys per year. Last year, the staff was increased again, to 42 persons, and the mission was moved up to 51 surveys per year. Each of these increases in staff and mission was due to demonstrated pay-offs of occupation information, and to increased demands from managers for more timely data. So far, the operational unit has surveyed over 200,000 enlisted persons in over 150 occupations. At present, 68 surveys are in various stages of completion, and plans have already been made for expanding the capability of the unit to meet the increased demands for more occupational data.

In the Air Force, the greatest pay-off from occupational data so far has been in the area of training. Significant changes have been made in every training course associated with an occupational survey. Frequently these changes have not led to cost savings, since they have been in the form of reducing training on certain tasks while increasing it on others. Even so, approximately $7,000,000.00 cost avoidance has been documented during the past two years alone, directly attributable to reductions in training based on occupational survey information.

Encouraged by Air Force occupational survey research findings, the Marine Corps established an operational unit which is currently manned by 37 persons, three of whom work full time in maintaining job structures. So far they have surveyed 11 of their occupational areas, which contain nearly one-third of their manpower. The Marine Corps had the Air Force CODAP system reprogrammed to operate on an IBM 360-65 computer. The job-typing programs have produced results leading to major changes in the job structures in every occupation surveyed thus far. During the past year, they have documented over $4,000,000.00 in cost avoidance based upon their occupational analysis results, a large savings considering the relatively small size of their personnel system. This year, the Marine Corps task analysis group received a Presidential Management Improvement Award.

The Army has an operational job-task analysis group consisting of 35 full-time persons. They have been collecting occupational data using job inventories for a number of years. To date, they have been using their own analysis programs, but they are planning several significant changes in their procedures. These include the collection of worker identification data, use of the relative time-spent factor for a portion of their task list, and use of the CODAP to supplement their own analysis system.

The Navy has recently conducted several large-scale occupational surveys using job inventories and processed the data with CODAP. The Navy officially established an operational job-task group this month and is pledged to use the CODAP system for analyses.

The Coast Guard has been conducting occupational surveys for several years with job inventories patterned after those used in the Air Force. All of their analyses thus far have been conducted using the CODAP system. They have now surveyed about one-third of their occupational areas.

The Canadian Forces have surveyed most of their occupations using job inventories, although, to date, they have used their own computer analysis programs. The Australian Air Force has 70 inventories in some stage of development. While these instruments tend to include a large number of task statements, they are otherwise patterned after those produced by the U. S. Air Force. An exchange officer from the Australian Air Force has recently completed a 2 1/2 year tour working in the Air Force occupational research program and studying the CODAP system. A second exchange officer has now moved into this position.

Many Universities, government agencies, and government contractors have collected occupational data using job inventories, and a number of these have accomplished their analyses using the CODAP system. To date, the CODAP system has not been available to industrial organizations, although it has been used by many non-profit organizations, especially those conducting research under government sponsorship.

All of these programs emphasize three points: First, there seems to be a large movement toward conducting occupational surveys using job inventories; second, many agencies are using, or are planning to use, the CODAP system for data analyses; and third, occupational analysis programs are generally in good health and expanding.

APPLICATIONS OF JOB SURVEY INFORMATION

Occupational data can and should have an impact on almost every part of the personnel system. The only thing lacking is the development of appropriate technology, and this is a major mission of the Air Force Occupational Research Division. Only a few of the applications being studied by this organization are mentioned.

Task-Level Experience Records

To my knowledge, no military service and few industrial organizations maintain individual work experience records at the work-task level. In the Air Force, a man may be assigned for a two-year period as a jet engine mechanic at a particular base and spend nearly all of this time working in a shop balancing jet engine rotors. When he is transferred to a new base, about all we know about him is that he spent two years at a particular base as a jet engine mechanic. We may assume that he gained experience on many maintenance tasks during this period which, in fact, he did not perform. We also have no record that he has received so much experience in balancing rotors.

Since a job inventory contains all the significant tasks being performed by personnel in an occupational area, it provides an ideal framework for establishing and maintaining individual experience records. Individuals can be trusted to provide an accurate statement of tasks currently being performed by using a job inventory. It may be that they can also be trusted to report their past experiences in terms of tasks listed in the inventory. This is a topic for research. Potential applications for task-level experience records: To evaluate the capabilities of the personnel force, to guide on-the-job training programs, to locate individuals with particular skills, and to guide reassignments.

Development of Task and Job Difficulty Indexes

One recent breakthrough by the occupational research group is the development of a technique for evaluating the relative difficulty levels of tasks and jobs in an occupational area (Mead, 1970a; 1970b; Mead & Christal, 1970). Task difficulty is a complicated concept. A task can be difficult to perform because repair parts are hard to get; the technical manual is hard to understand; the environment is hot; and several other reasons. After considering many alternatives, a definition was selected which reflects the amount of time it takes for individuals to learn to perform a task adequately. Supervisors in an occupation cannot rate the time it takes for workers to learn to perform tasks; but they can agree that, other factors held constant, workers can learn to perform some tasks faster or slower than they learn to perform other tasks. Inter-rater reliability coefficients concerning the relative difficulty of tasks within an occupation, based upon 30 to 40 raters, generally range in the middle to upper 90's.

An equation has also been developed which enables us to determine the relative difficulty levels of jobs within an occupation. First, we used the CODAP system to randomly select and publish multiple copies of 250 individual job descriptions in one career ladder. Then supervisors in the field ranked these jobs in terms of their relative difficulty levels. Again, we found high inter-rater agreement. Using the job rankings as a criterion vector, we applied the policy-capturing model (Christal, 1968a; 1968b; Bottenberg & Christal, 1968) in an attempt to develop an equation which would reproduce the policy decisions of the supervisors concerning job difficulties. Twenty-two predictors were hypothesized; but only three predictors entered into the equation. The same approach was repeated in 11 other ladders, and in every instance, the same three predictors were able to reproduce the supervisory rankings. These results are shown in Table 1.

Let's study this table for a minute. First notice the three predictors. Predictor 1 is the number of tasks in the job, and Predictor 2 is the number of tasks squared. Inclusion of the squared term is necessary because there is a curvilinear relationship between the number of tasks in jobs and their perceived difficulty levels. Predictor 3 is a complex variable reflecting the average difficulty level of tasks performed per unit time. This variable is computed by the CODAP Variable Generation Program (VARGEN), and is simply the cross-products of time spent and task difficulty, summed across all tasks in the inventory for a particular job.

Notice that when these three variables are properly weighted, the resulting composite shows remarkable ability to predict the supervisory job difficulty rankings. Also notice the standard score weights in all 12 equations look very similar. As a matter of fact, they looked so similar that we began to wonder if it might not be possible to develop a universal job difficulty equation. In order to run a first test of this hypothesis, we averaged the standard score weights across the 12 ladders for each predictor; then we applied this single general equation back to the 12 samples to determine its predictive efficiency. Table 2 presents the results from this exercise.[2] Notice that in every instance, the general equation is almost as efficient as the least squares equation developed within the sample.

All of the career ladders shown in Tables 1 and 2 are relatively low level, and there is some question as to whether the general equation will be applicable to more technical occupations. In one recent study the general equation yielded a valid coefficient of .89 for the information career ladder, which is moderately encouraging, and .80 for the Weather Observer career ladder, which is not so encouraging. If it turns out that the general equation holds up, we will no longer have to go to

Table 1. **Standard Score Job Difficulty Equations for 12 Career Ladders**

AFSC	Name	V1 Num Task	V2 Num Tasks Squared	V3 Avg Task Diff Per Unit Time	Validity
915X0	Medical Materiel	1.12583	−0.58673	0.45263	.949
811X0	Security Police	1.21517	−0.69250	0.49006	.922
702X0	Administrative	1.51433	−0.78250	0.24270	.977
671X0	Acctg & Finance	1.58511	−0.95836	0.39230	.951
647X0	Materiel Facilities	1.47237	−0.87075	0.33103	.942
645X0	Inventory Management	1.82866	−1.14425	0.22359	.936
631X0	Fuel Services	1.36857	−0.81885	0.49672	.942
605X0	Air Transportation	1.69565	−1.07968	0.30385	.930
571X0	Fire Protection	0.93890	−0.50649	0.66558	.939
551X0	Amn. Civ. Eng.; Pavements	1.38743	−0.77055	0.28059	.928
543X0	Elec. Power Production	1.66067	−0.94110	0.20593	.937
473X0	Vehicle Maintenance	1.29126	−0.61530	0.51612	.927
	General Equation	1.42366	−0.81392	0.38343	

Table 2. **Efficiency of the Job Difficulty General Equation**

Specialty	Name of Specialty	Least Squares R	General Equation R
811XX	Security Police	.922	.914
702XX	Administrative	.977	.970
671XX	Accounting and Finance	.951	.950
647XX	Materiel Facilities	.942	.930
645XX	Inventory Management	.936	.917
631XX	Fuel Services	.942	.938
605XX	Air Transportation	.930	.925
571XX	Fire Protection	.939	.888
551XX	Civil Engineering, Pavements	.928	.925
543XX	Electrical Power Production	.937	.923
473XX	Vehicle Maintenance	.927	.916

the trouble of establishing criterion vectors. We will simply have 30 to 40 supervisors in each area rate the task difficulties; then we can apply the general equation to determine the difficulty levels of all jobs surveyed. We already have programs in the CODAP system for performing the necessary computations.

Discussion of a few of the applications made of task and job difficulty indexes:

Technical School Versus On-The-Job Training

In over 30 career ladders, the Air Force has established what it calls a Category B training plan. Under this plan, a proportion of the assignees to the ladder are sent directly to the field with no formal training, while the remaining individuals go through an entry-level resident training course, and then are sent to the field. One would think that, if there is any flexibility in work assignment, those who have had the benefit of formal resident training would tend to inherit the more complex and difficult jobs. We have tested this hypothesis, using the job difficulty index as one criterion. The analysis is a model-seeking design, with two treatments and a concomitant variable. The two treatments are Technical School Graduates (TSG) and Directed Duty Assignees (DDA); the concomitant variable is Time in Military Service (TMS); the criterion is job difficulty level; and aptitude is held constant. Figure 1 shows some of the possible models.

Model A shows an unlikely situation where the difficulty of work does not change over time, and where the regression lines for TSGs and DDAs are identical. Model B shows job difficulty increasing over time, but again, the regression lines for the two groups are identical. Model C shows the difficulty level of work increasing over time, and the regression lines to be parallel: but at all points in time, the TSGs are inheriting more complicated jobs than the DDAs. Model D was considered to be the most likely. It shows the difficulty level of work increasing for both groups over time. However, during the early time period, the TSGs are being assigned less difficult work than the DDAs. This makes sense, since the DDAs will have been on the job while the TSGs were in the classroom. However, Model D shows the TSGs catching up with and passing the DDAs in terms of the difficulty level of work inherited. The basic question is when does this cross-over occur. With a re-enlistment rate of 20 or 30 percent, it needs to occur well before the end of the first enlistment if the technical training course is to be worth its cost. The analysis program locates the appropriate model and reports all the parameter values.

Detailed results from application of the model to eight career ladders are reported by Lecznar (1972). In general, Model B was found to be the correct representation. That is, while the difficulty levels of jobs increased over time, at no point (between the 5th and 35th month of service) was one group revealed to perform more difficult jobs than the other. The same type analysis was run against five other criteria: (a) number of

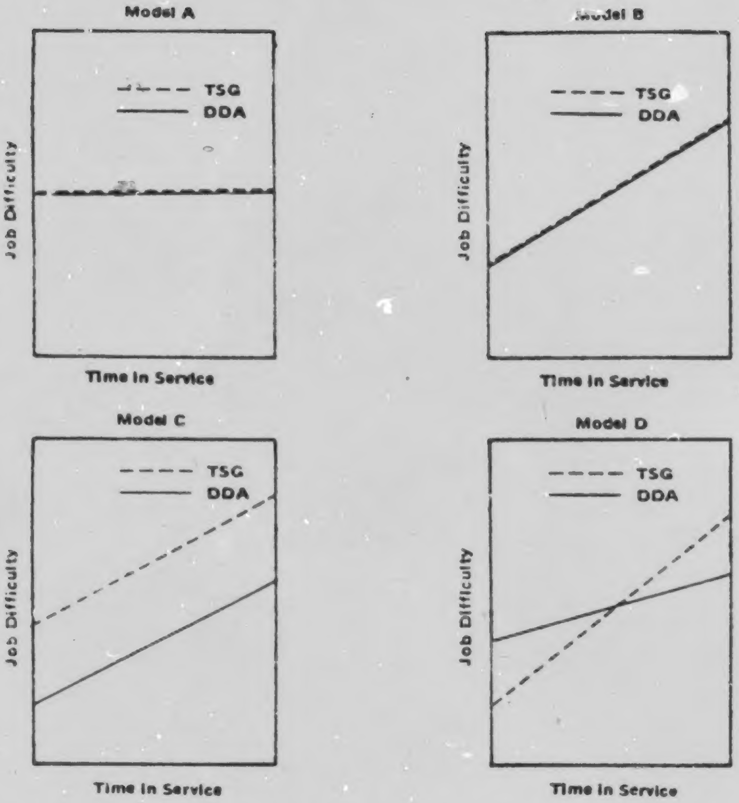

Fig. 1. Comparison of technical school graduates and directed duty assignees in terms of difficulty level of work inherited.

tasks performed, (b) average difficulty level of tasks performed per unit time, (c) official airman performance ratings, (d) job interest, and (e) felt utilization of training and talents.

With few minor exceptions, no differences were found between TSGs and DDAs in any of these analyses. Figure 2 displays results for the Communications Center Career Ladder (291X0). The regression lines are identical for TSGs and DDAs against all criteria except for the number of tasks performed. There is a slight tendency for those trained on the job to perform more tasks than those trained in the formal entry-level course.

There has been a concerted effort in the Air Force to make On-the-Job Training (OJT) programs equivalent to resident training programs for the Category B areas. This study provides more evidence that equivalency is being attained. As an interesting side-light, a recent study has been completed comparing the relative costs of resident training versus OJT for the 291X0 Career Ladder (Dunham, 1972). The results of this study indicated the cost of technical school training to be $2,780, while the

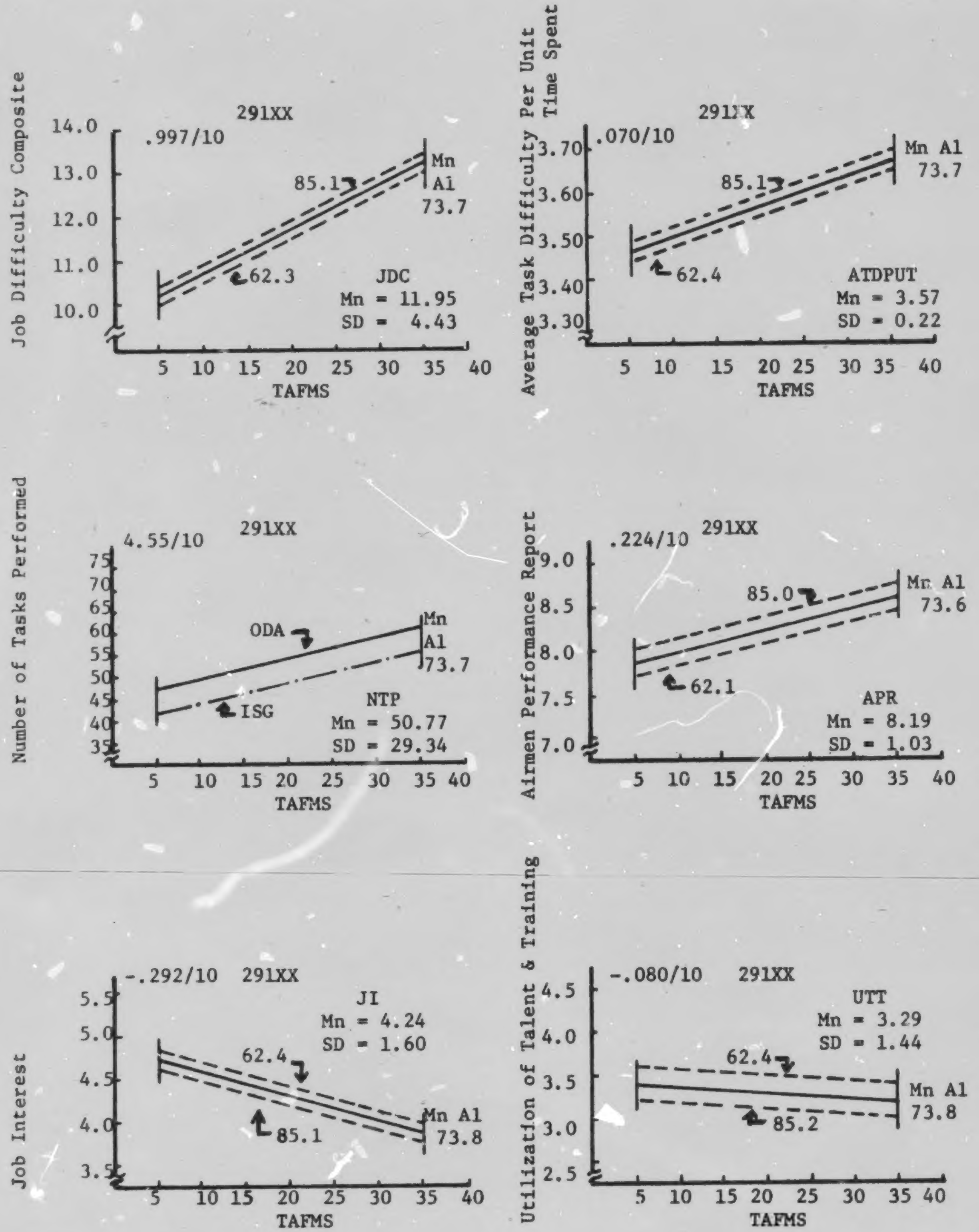

Figure 2. Comparison of technical school graduates and directed duty assignees on various criteria

cost of OJT was estimated to be \$1,311 (median cost estimate). The upper limit of OJT cost estimates (95% confidence) was reported to be \$1,515, still considerably less than the reported cost of resident training. Most of this difference is attributable to the cost of equipment, maintenance, training aids, and administration, which are calculated to be considerably less for on-site training.

Difficulty of Work Assigned to Personnel as a Function of Their Aptitude Levels

In 1967 the Department of Defense established a program titled "Project 100,000" which required the military services to accept quotas of personnel who fell below previously operating mental standards. The Air Force initiated a number of studies to determine how these individuals succeeded during their first enlistment (four years). Data were easily obtained concerning elimination rates in basic training, technical schools, and during post-school service. Scores were also available on written proficiency tests and official performance rating forms. However, there was one matter which plagued the investigators: "How do we know that these individuals are not being assigned tasks to perform as a function of their aptitude levels?" True, aptitude scores were not being provided to supervisory personnel. However, a supervisor might perceive some of his subordinates are more talented than others, and might assign the brighter airmen to do the complicated tasks, while assigning tasks such as sweeping the floor to airmen perceived as being "dull." And if a "dullard" does an excellent job of sweeping the floor (his assigned task) and if he does it with a good attitude and enthusiasm, will the supervisor give him a bad performance rating? Answer: Probably not." Since the Air Force can use only so many floor sweepers in a specialty, it was deemed important not to draw any conclusions about the success of "New Mental Standards" (NMS) airmen until it was determined whether they had been given differential treatment as a function of their ability.

Since the definition of New Mental Standards airmen changed several times during the course of Project 100,000, the question was generalized to evaluate the difficulty of work assigned personnel as a function of their aptitude levels (Wiley, 1972). Data were collected using job inventories from approximately 14,000 airmen in 11 career ladders which had received large inputs of low aptitude personnel. In fact, approximately 47% of the cases (6,520) were Category IV personnel, while nearly 27% of the cases were classified as New Mental Standards airmen.[3]

The data were analyzed using the Multiple Linear Regression Model. In general, the approach was to determine the unique contribution of aptitude in accounting for the variance in (a) job difficulty, (b) the n number of tasks performed, and (c) the Average Task Difficulty Per Unit Time (ATDPUT). Variables such as in-service training, time-in-service, time-in-job, grade, job location, command assignment, etc., were held constant. Results of these analyses are summarized in Table 3.

TABLE 3. UNIQUE CONTRIBUTION OF APTITUDE (AFQT) IN PREDICTING DIFFICULTY OF WORK ASSIGNED

		Unique Contribution of Aptitude to R^2		
AFSC	N	ATDPUT[a]	# Tasks	Job Difficulty[b]
291X0	862	.014[b]	.001	.006
473X0/1	720	.011[c]	.004	.000
543X0	470	.002	.021[c]	.019[c]
551X0/1	835	.006	.001	.002
571X0	1,214	.006[c]	.001	.002
605X0/1	813	.001	.000	.004
631X0	875	.011[b]	.004	.003
645X0	1,567	.007[c]	.001	.002
647X0	1,469	.011[b]	.011[b]	.013[b]
702X0	2,452	.019[b]	.005	.011[b]
811X0	2,644	.022[b]	.000	.004

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[a] Average Task Difficulty Per Unit Time
[b] Sign. at .01 level
[c] Sign. at .05 level

Although several of the R^2s in Table 3 are significant at the .05 or .01 levels, in no instance did the unique contribution of aptitude exceed .02. It was concluded that there was no practical difference in the difficulty level of work being assigned to personnel in these 11 ladders as a function of their aptitude levels. Various interpretations can be placed upon this finding. It could be that supervisors in these ladders have very little flexibility in the way that they can assign work to subordinates. Another, and possibly more straight-forward interpretation, is that personnel assigned to these ladders have sufficient aptitude to perform all available tasks. In any event, it appears that the NMS airmen did not receive differential treatment with respect to their work assignments.

One unexpected finding was that, in nearly all Air Force Specialties (AFSs), aptitude correlated higher with the ATDPUT variable than it did with the job difficulty composite. A tendency was observed in several ladders for supervisors to assign fewer, but more complex tasks, to the brighter personnel. The significance of this finding will be discussed later.

Differences in Work Assigned to Blacks and Non-Blacks

Since approximately 19% of the cases in the NMS airman study described above were Black, the data provided an ideal base for analyzing racial differences on variables such as the difficulty of work assigned, job interest, and felt utilization (Christal, 1972). Table 4 presents zero-order correlations between Race (Black =1; 0 otherwise) and selected variables within each of the 11 career ladders in the NMS study. Although some of the relationships reported in this table are significant, they are all very low. The more meaningful findings are reported in Table 5, which displays the unique contribution of Race in the prediction of the job assignment-satisfaction criteria. The variables held constant in each equation are presented in Table. 6.

Three of the criteria are associated with the nature of work being performed by incumbents in the various career ladders: (*a*) the number of tasks being performed, (*b*) the average task difficulty per unit time, and (*c*) an index of job difficulty. As indicated in Table 6, the variables held constant related to age, training, aptitude, education, and experience. When these variables were held constant, it was found that there were no significant differences in the number of tasks being assigned to Blacks and Non-Blacks in the samples under consideration. Furthermore, there were no significant differences in the average difficulty levels of tasks performed, weighted by the time spent on each task. However, when these two criteria were weighted into an index of overall difficulty level, it was found that Blacks were being assigned significantly less difficult jobs in two career ladders: 605X0 Air Passenger/Air Cargo and 702X0 Administrative. Although these differences were statistically significant at the .01 level, they were, nevertheless, small. In each instance, the race variable uniquely accounted for less than 1% of the criterion variance.

Table 5 also reflects racial differences in expressed job interest and in reported utilization of talents and training. Significant racial differences appeared in only two career ladders. In each instance, however, they were in the direction that suggested the Blacks found their jobs more interesting and felt that their talents and training were being better utilized than did the Non-Blacks. These findings are unusual in two respects. First, in the case of the 291X0 Communications Center Ladder, the unique contribution of race in accounting for feelings of being well utilized had an *F* ratio of 27.48, which is highly significant. Even though the Blacks and Non-Blacks were being assigned jobs and tasks of comparable difficulty levels in this ladder, the Blacks felt that they were being better utilized. In the case of the 702X0 Administrative Career Ladder, it was found that the Blacks were being assigned jobs which were slightly less difficult than jobs assigned the Non-Blacks. In spite of this, the Blacks expressed a higher feeling of utilization and job interest than did the Non-Blacks. In the remaining nine career ladders, there were no significant differences in expressed attitudes.

Prediction of Civilian Grade Classification and Analysis of Biases in Classification Actions

Until recently, Air Force experience in conducting occupational surveys with job inventories was restricted to enlisted and officer samples. Analyses revealed survey data to be of good quality. In 1971 a first attempt was made to survey Civil Service personnel (Garza, 1972). Since civilian grades are tied to job content, there was some fear that a civilian might feel he had something to gain by being dishonest, or

TABLE 4. CORRELATIONS BETWEEN RACE AND SELECTED VARIABLES IN 11 CAREER LADDERS

	Career Ladder										
Variable	291	473	543	551	571	605	631	645	647	702	811
Job Difficulty Index	-.01	.03	.05	-.06	.01	-.09	-.09	-.06	.06	-.09[a]	-.04
No. Tasks Performed	.02	.05	.06	-.06	.04	-.06	-.04	-.03	.06	-.07	.00
ATDPUT	-.08	-.01	-.03	-.04	-.03	-.11[a]	-.10[a]	-.01	.03	-.06	-.07[a]
Job Interest	.15[a]	.02	.10	-.12[a]	.02	-.02	-.01	-.09[a]	.06	-.09[a]	-.01
Felt Utilization of Talents & Training	.26[a]	.00	.15[a]	-.04	-.00	.01	-.00	.12	.04	-.12[a]	.02
N	691	538	373	643	1,003	714	724	1,397	1,262	1,944	2,109
% Black	12.0	8.4	18.2	21.3	23.8	14.3	23.2	11.8	22.1	23.0	23.3

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[a] Significant at the .01 level of confidence.

TABLE 5. UNIQUE CONTRIBUTION OF RACE IN ACCOUNTING FOR
THE VARIANCE IN CERTAIN MEASURES OF JOB ASSIGNMENT AND JOB SATISFACTION

	Unique Contribution of Race by Career Field										
Criteria	291	473	543	551	571	605	631	645	647	702	811
Job Difficulty	.0000	.0000	.0000	.0061	.0000	(-).0095[a]	.0079	.0029	.0006	(-).0041[a]	.0000
No. of Tasks	.0000	.0000	.0000	.0076	.0000	.0036	.0030	.0004	.0007	.0019	.0000
ATDPUT	.0026	.0000	.0000	.0026	.0021	.0048	.0050	.0014	.0000	.0000	.0011
Job Interest	(+).0097[a]	.0000	.0007	.0073	.0000	.0003	.0000	.0002	.0000	(+).0051[a]	.0015
Felt Utilization of Talents & Training	(+).0340[a]	.0000	.0100	.0012	.0003	.0000	.0000	.0016	.0000	(+).0066[a]	.0000

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[a] Significant at the .01 level of confidence

something to lose by being honest in describing his job. Fortunately, there was no indication of distortion in the data received from 5,485 job incumbents surveyed in seven series of the Accounting and Finance occupational area. Several analyses were made of these data (Carpenter & Christal, 1972) which utilized task and job difficulty indexes. One involved an attempt to predict the official grade classification of each position, and the second involved an analysis to detect biases in grade classification actions. The reader should understand that grade classification actions are based upon job descriptions provided to the classifier by the supervisor, while the analyses reported below are based entirely upon data reported by job incumbents in job inventory forms.

Table 7 indicates multiple Rs which were obtained from information concerning the amount of time spent by incumbents on particular tasks. In order to reduce the problem of overfitting, the tasks were split into two problems, and those entering either equation were used as predictors in a third problem. Although this did not completely eliminate capitalization on chance, it did reduce it to tolerable limits, considering the number of criterion observations available.

The task variables which entered the composite model were then combined with certain background variables to predict authorized GS grade. These background variables included those relating to the difficulty level of the job (Number of tasks, ATDPUT, and Job Difficulty Index); job location; command; personal characteristics of the incumbent (such as sex, age, marital status, etc.); and a large number of incumbent experiences and training variables. Readers who wish detailed information concerning the subsequent analyses can refer to the published report (Carpenter & Christal, 1972). A series of full and restricted regression models was computed to determine whether non-job-related variables had influenced grade classification actions. In general, it was found that factors such as the incumbent's age, sex, marital status, and factors such as command assignment and job location, did not systematically demonstrate a significant source of bias in grade determinations. One exception was the discovery that jobs in the Washington DC area are classified about one-half grade level higher than jobs located elsewhere, other factors held constant.

Table 8 presents the zero validity coefficients of the Number of Tasks Performed, ATDPUT, and the Job Difficulty Index (computed with the general equation) for the authorized GS grade levels of jobs in the seven series. Except in the 520 and 540 series, the ATDPUT variable showed substantial validity for all series. One discouraging finding was that in three ladders, the job difficulty equation, as computed by the general equation, had less validity than one of the individual variables weighted into the equation. Although the general equation may universally predict supervisor's ratings of job difficulty, it would appear wise to retain the separate elements of the equation in attempting to predict other criteria.

Table 6. **Predictors Used to Account for Variance in Selected Criteria**

Predictor	Criterion: Job Difficulty Index	Number of Tasks Performed	Avg Task Difficulty Per Unit Time	Job Interest	Felt Utilization of Talents and Training
Months in Job	x	x	x	x	x
Months in Career Ladder	x	x	x	x	x
Total Months Active Military Service	x	x	x	x	x
Years of Education	x	x	x	x	x
AFQT Centile	x	x	x	x	x
AQE Mechanical AI	x	x	x	x	x
AQE Administrative AI	x	x	x	x	x
AQE General AI	x	x	x	x	x
AQE Electronics AI	x	x	x	x	x
Technical School Graduation (Yes/No)	x	x	x	x	x
Age at Enlistment	x	x	x	x	x
Job Difficulty Index				x	x
Number of Tasks Performed				x	x
Average Task Difficulty Per Unit Time				x	x
Grade				x	x
Number of Subordinates				x	x
CONUS Assignment				x	x

TABLE 7. CORRELATION OF TASK VARIABLES WITH AUTHORIZED GS GRADE

		Group A		Group B		Composite	
GS Series	N	# VARs Entering	Mult. R	# VARs Entering	Mult. R	# VARs Entering	Mult. R
501	856	68	.741	73	.755	77	.813
520	1,305	55	.564	49	.582	76	.649
525	1,710	66	.720	69	.691	81	.755
530	203	39	.869	36	.896	38	.924
540	307	49	.724	49	.752	65	.819
544	604	29	.725	32	.759	44	.793
545	500	41	.772	48	.752	57	.805

TABLE 8. VALIDITY OF CERTAIN MEASURES OF JOB DIFFICULTY FOR PREDICTING AUTHORIZED GS GRADE CLASSIFICATION

	GS Series						
Predictor	501	520	525	530	540	544	545
ATDPUT[a]	.51	.17	.54	.47	.23	.58	.51
No. of Tasks Performed	.25	.20	.23	.65	.18	.35	.32
Job Difficulty Index	.45	.30	.39	.67	.29	.46	.51

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[a] Average Task Difficulty Per Unit Time

Task Factor Approach to Job Evaluation

Task Factor Approach to Job Evaluation

Another potentially important use of occupational data is in the area of job evaluation--the process by which pay and grade requirements are associated with jobs. Although there are a number of approaches to job evaluation, most large agencies use some type of point rating system. In such a system, each job is rated on a series of job evaluation factors, and the factor ratings are weighted into a job evaluation composite score. The job evaluation composite score is, in turn, converted into a grade or pay requirements level. The factors and factor weights employed in many job evaluation systems are in reality regressions equations developed to predict agreed-upon grade or pay levels for a set of benchmark jobs.

Although development of a job evaluation system is relatively straight-forward, applying it is another matter. How does one obtain unbiased factor ratings on tens or hundreds of thousands of jobs? We are working on a system using task-level data which may be of interest to you. Instead of obtaining factor ratings on jobs, we are obtaining them on tasks which have been included in job inventories. Since every job in an occupation can be described in terms of the tasks in an inventory, we can simply apply CODAP and compute the factor scores for each job. Also, CODAP can be applied to weight the factor ratings for each job into a job evaluation composite. This process assures that job evaluation is conducted in a systematic and unbiased manner.

In one recent test of this technology, an attempt was made to develop a system for evaluating the skill-level requirements for jobs in two Air Force career ladders. Task-level job descriptions were published using the CODAP system for 400 positions in the Fuel Services ladder (631XX) and 677 positions in the Personnel career ladder (732XX). These descriptions were rated for appropriate skill-level requirements by senior supervisors in the field, yielding mean ratings with computed inter-rater reliability coefficients of .95 and .92, respectively.

An independent group of supervisors in each ladder rated all tasks in a job inventory for their ladder on a series of job evaluation factors, such as knowledge requirements; responsibility for use and control of money, supplies, or equipment; required special training and work experience; oral and written communications; supervisory responsibility; decision-making requirements; task difficulty; etc. All such ratings were collected using an 8-point relative task comparison scale. The instructions went something like this: "Compared with other tasks in your career ladder, when a man is performing this task, what level of communications skill is he exercising?" If no communication skills are required, the task is assigned a value of "0." If communication skills are involved in performing the task, rating of from 1 to 7 is assigned, according to the level of requirement compared with other tasks in the ladder. Reliability coefficients for the various factors (based on vector of mean ratings) ranged from .93 to .99.

Scores were developed on each job description for each factor using the CODAP system. For example, one variable reflected "the average level of communication skills exercised per unit time." For a particular case, this is simply a sum of the cross-products of the time spent values and task indexes, across all tasks in the inventory. The factor information was then combined with other job information, such as the number of subordinates supervised, in an attempt to predict the supervisory skill-level criterion ratings.

It was found that a major portion of the criterion variance could be accounted for by only four variables plus two squared terms, as follows:

1. Number of tasks performed
2. Number of tasks performed, squared
3. Number of subordinates
4. Number of subordinates, squared
5. ATDPUT (Average Task Difficulty Per Unit Time)
6. ADMPUT (Average Decision-Making Requirement Per Unit Time)

TABLE 9. PREDICTION OF SKILL LEVEL REQUIREMENTS FOR JOBS IN TWO AIR FORCE CAREER LADDERS[a]

Career Ladder	N Jobs	R Full Model	R 6-Predictor Model
Fuel Services	400	.96	.95
Personnel	677	.94	.92

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[a] See Text for definition of predictors.

Table 9 reports the Multiple Correlation Coefficients for the full model (33 predictors) and for the six variables previously shown. It should be noted that application of the six-variable equations require obtaining task ratings from supervisors on only two factors: Task Difficulty and Decision-Making Requirement. The number of tasks performed by each worker is automatically computed by CODAP, and the number of subordinates is normally obtained by a background question included in job inventories. The two squared terms in the equation were required in order to account for anticipated curvilinear relationships. The number of tasks in jobs normally increases from the apprentice level through the first-line supervisory level; then falls off somewhat at the superintendent level. This is because a first-line supervisor both supervises and performs tasks, while a superintendent normally does not perform journeyman-level tasks. In a like manner, the number of immediate subordinates reaches a peak at the first-line supervisor level. Note all three variables which enter into the Job Difficulty Equation entered into the skill-level equation for the two ladders.

Use of Task Difficulty Indexes in Determining Training Requirements

In the Air Force we have saved millions of dollars by eliminating training on tasks which occupational survey data have revealed to be performed by few workers. However, data concerning the probability of school graduates doing certain tasks in their first or second assignment is insufficient to make sound decisions concerning school curricula (Christal, 1970). We are attempting to collect additional information on each task in an inventory in order to determine how much emphasis should be given to it in the entry-level course. These factors give consideration to such things as the consequences of inadequate performance; the probability that the task can be performed adequately without specialized training; the estimated cost of teaching the task in a formal training course as compared with teaching it on the job; the probability that the task may have to be performed in an emergency condition, where there is no time to obtain information on how it should be done; the perishability of the skill; and so on. The method for combining such information into curriculum decisions is not simple. For example, ordinarily a task will not be included in a course if the probability of a worker having to perform it is very low. On the other hand, if the task might have to be accomplished in an emergency, such as performing mouth-to-mouth resuscitation, or fighting a certain type of chemical fire, or evaluating a radiation count--and if the consequences of inadequate performance are serious, and if the probability of being able to perform the task adequately without formal training is low--then it certainly should be included in the entry-level course. Our goal is to develop procedures for evaluating each task on factors such as those described above, and to develop equations which can be applied to each task to determine how much emphasis should be given to it in the training course.

Data on factors such as those previously mentioned have been collected on tasks in the Medical Services Career Ladder. Analyses revealed that correlation between Task Difficulty Indexes and the rater "probability of adequate performance without specialized training" was .96. Thus, once again, Task Difficulty Indexes, where difficulty is defined in terms of relative time to learn, will assist in solving an operational problem.

Two points concerning the application of occupational data to training are: First, one simply cannot provide massive computer printouts of occupational information and expect trainers to use them. It is necessary to explain how the data can be used and also to convince trainers that the data are trustworthy. In some instances, trainers may be reluctant to eliminate training or tasks, even though there is overpowering evidence that such a move would be cost effective. In the Air Force, directives have been issued which require trainers to review survey data and "show cause" as to why tasks performed by few workers should be included in the entry-level course. Second, a course curriculum cannot be designed solely from job survey data. Once the tasks to be trained have been identified, trainers must go into the field to observe the number and sequence of steps required in the performance of each task to be included in the course.

Determination of Relative Aptitude Requirements Using a Benchmark Scale

Aptitude requirement levels for entry into various Air Force career ladders were initially established by judgment. Adjustments have been made from time to time, based on recommendations from field commanders and trainers. When an aptitude requirement has been raised, it has generally been because someone has gone to a great deal of trouble documenting the fact that the jobs in an occupational field have become more complex and demanding. Requirements for new career ladders have been set by comparing them with similar existing career ladders. The subtests entering into aptitude composites have routinely been validated against training course grades; but only in a few instances have attempts been made to correlate subtests or composites with actual performance on the job. This has been due mainly to the non-existence of acceptable job performance measures.

Many times during the past 25 years, Hq USAF has validated aptitude requirements for all career ladders. In each instance, soft answers were provided. At present, it is not possible to defend any level of aptitude as being an absolute minimum for success in a career ladder. If training is carefully designed and increased, individuals with lower aptitude might succeed who otherwise would not. Job performance aids and automatic checkout equipment can reduce requirements for high aptitude personnel in some ladders. Given sufficient time on the job, low aptitude personnel can learn to perform many tasks which they could not learn in a short period of time. There are many such factors that have trade-off values with aptitude. Even if factors such as training, experience, and performance aids are held constant, there is still no completely satisfactory way to establish aptitude minimums in the absence of objective work performance standards and a method of evaluating personnel against such standards.

Yet, the matter of setting realistic aptitude requirements can be extremely important. For example, lowering a requirement from the 80th to the 60th centile could double the number of individuals eligible to volunteer for service in a particular career ladder. As we have moved into a zero-draft environment, there has already been some degradation of high aptitude talent in the applicant pool. A point may be reached where it is no longer possible to fill quotas at stated requirement levels. What then?

One solution would be to generate more applicants through offerings of increased pay and benefits. However, predictions of lower budgets and expenditures on national defense do not make this approach look promising. It may become necessary to find some way of operating the force with less talent. This being the case, now is the time to begin building contingency plans for actions which could be taken if trouble is encountered.

During the course of some of the studies described earlier in this paper, several members of the occupational research team developed a strong feeling that task and job difficulty, defined in terms of time to learn, reflects aptitude requirements. Some support for this hypothesis can be found from the results of training research. If training time is held constant, aptitude relates to the amount of material mastered; but if everyone is trained to a standard and allowed to move at his own pace, aptitude relates to training time. Another clue came from a study in which we computed a correlation of .92 between supervisory ratings of task difficulty and the proportions of an independent group of supervisors agreeing that tasks could be performed adequately by low ability workers.

Following these clues, a series of systematic studies were initiated to determine the relationship between relative aptitude requirements for work tasks as judged by behavioral scientists, and relative difficulty levels for the same tasks as judged by supervisors (Fugill, 1972; 1973). In the first study, a correlation of .89 was obtained for a set of mechanical tasks. In a follow-on study, a correlation of .93 was obtained for a set of electronic tasks. Finally, a correlation of .89 was obtained for a set of administrative tasks. Thus, a close correspondence between difficulty defined in terms of "time to learn" and aptitude requirements was established.

These findings suggest that one can use relative difficulty ratings from supervisors to compare the relative aptitude requirements for tasks and jobs _within_ career ladders. This information alone can be of some benefit for building contingency plans. For example, most career ladders contain several types of jobs which may vary in difficulty. The CODAP analysis system can be used to identify these job types, and difficulty indexes can be used to determine which job types might be shredded out into new management units for performance by lower aptitude personnel. The task difficulty indexes can also be used to identify tasks which might be pulled out of existing jobs and engineered into new jobs for performance by less talented individuals. However, in order to build the most meaningful contingency plans, what is needed is a method for comparing aptitude requirement levels for jobs across all career ladders. This would help the Air Force determine where stated requirements can be reduced with the least danger to mission accomplishment, and without changes in the classification structures. The approach taken to solve this problem was the development and application of benchmark scales.

This approach can be outlined in general terms.

Step 1. Select a set of career ladders requiring the same type of aptitudes, for which job inventories and recent occupational survey data are available.

Step 2. Collect ratings from supervisors to determine the relative difficulty levels of _all_ tasks within each ladder.

Step 3. Select 30 to 40 tasks at various difficulty levels from each ladder. This will form the benchmark set. Reilability of final results will be enhanced if the tasks selected for the benchmark set are well known or easily observed.

Step 4. Obtain relative aptitude requirement ratings for tasks in the benchmark set from knowledgeable behavioral scientists.

Step 5. Within each ladder, compute least squares regression equations to predict task aptitude requirements from task difficulty levels.

Step 6. Apply the equations developed in Step 5 to re-scale all tasks in all ladders into a common aptitude requirements framework (the benchmark scale).

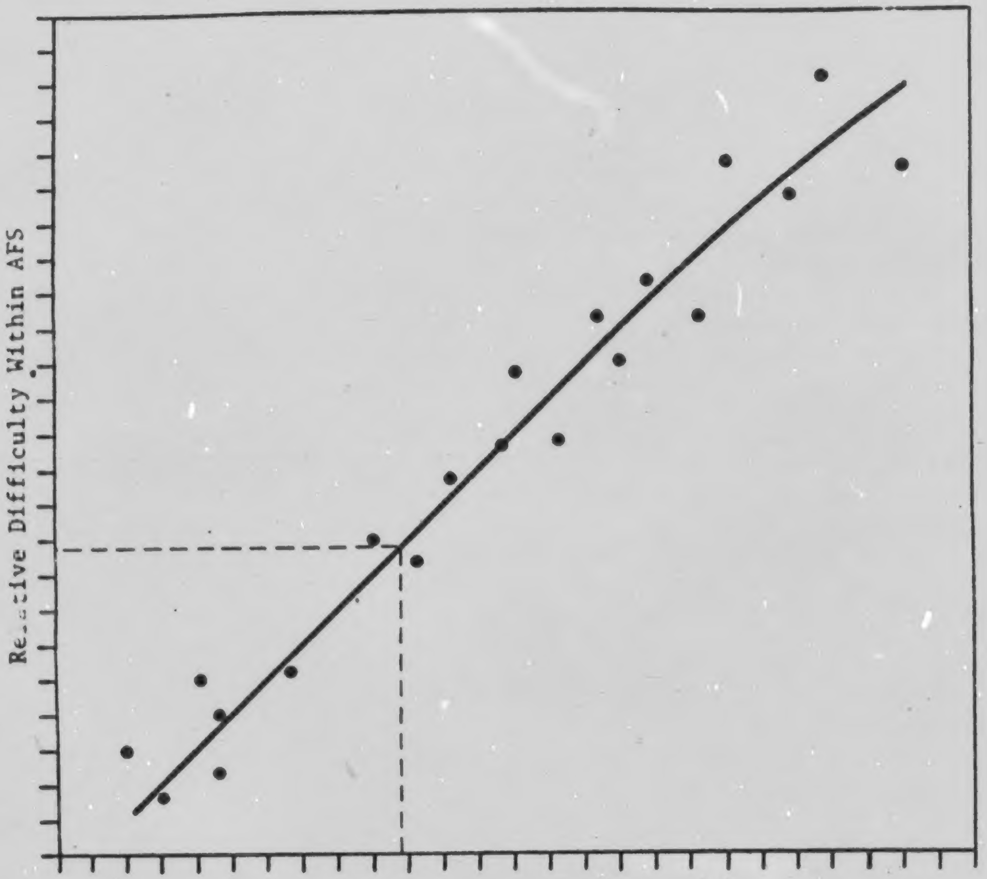

Figure 3. Relative Aptitude Requirement Within Benchmark Set

Figure 3 presents 20 points representing 20 tasks on a particular career ladder which were included in the benchmark set. The position of a task on the vertical axis represents its difficulty level relative to all other tasks in its own career ladder. Its position on the horizontal axis represents its aptitude requirement level relative to other tasks in the benchmark set of tasks. A line of best fit has been drawn through the points. Using this graph, the relative difficulty index values can be converted into aptitude requirement levels for all tasks in the career ladder. If this procedure is repeated for all ladders having tasks represented in the benchmark set, the final product is a set of values indicating the relative aptitude requirement levels for all tasks in all ladders. The same results can be obtained, without actually plotting points and reading graphs, by simply developing and applying least-squares regression formulae.

Step 7. Using the task aptitude requirement data, the CODAP system is applied to occupational survey data to determine the relative aptitude requirement levels for all jobs in all ladders.

Step 8. The requirement levels for 1st term jobs are compared across ladders.

Step 9. The requirements levels are determined for each type of job identified in each career ladder by the CODAP system.

Step 10. The amount of work time being spent on low requirement tasks is determined for each job in every career ladder.

A test application of this technology was made by the Air Force Human Resources Laboratory's Occupational Research Division. Part of this study was accomplished in-house, and partly by contract with the Systems Development Corporation. Generally, the study was conducted as follows:

In the first stage, an in-house study was completed which involved 10 ladders in the Administrative and General aptitude areas. Two hundred seven tasks were selected for inclusion in the benchmark scale, which represented the range of difficulty in each ladder. As a second consideration, the tasks selected were those which in-service personnel were most likely to understand without observation in the field. Twelve in-service behavior scientists rated tasks in the benchmark set on relative aptitude requirements, and 40 to 100 supervisors in the field rated all tasks within their respective career ladders on a relative difficulty scale. Correlations between task difficulty levels and aptitude requirement levels were generally in the upper 80's for the benchmark tasks representing various ladders. Regression equations were computed and applied to re-scale all tasks in all ladders in terms of their relative aptitude requirement levels.

Realizing the dangers of having in-service personnel rate tasks without first-hand knowledge, a contract was negotiated with Systems Development Corporation to repeat the study on 10 career ladders, six of which were

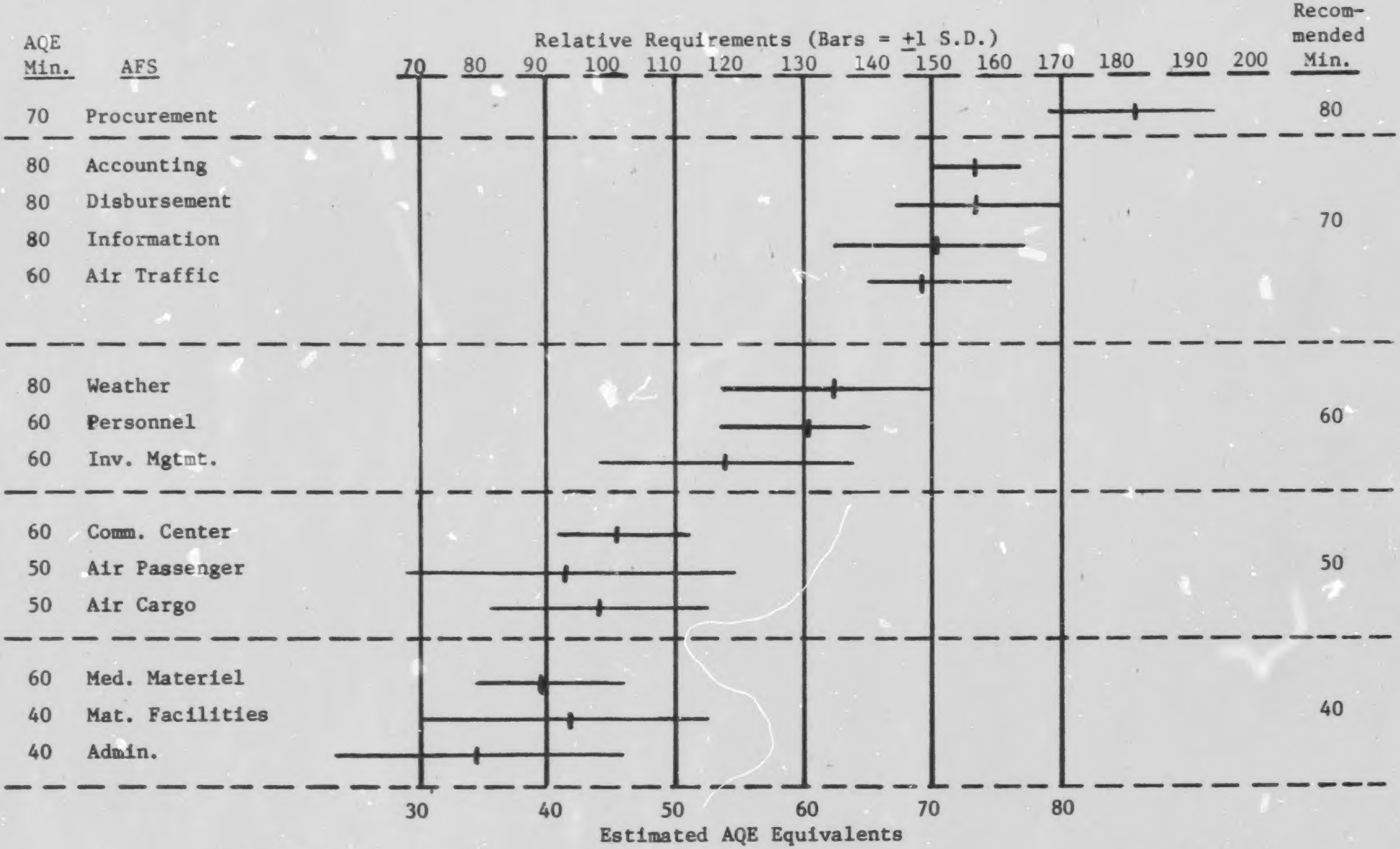

Figure 4. Relative Aptitude Requirements for 1st-Termer Jobs.

identical to those in the in-house study. The contractor study involved 280 benchmark tasks. Six behavioral scientists spent six weeks at several bases observing these 280 tasks being performed and interviewing workers and supervisors before executing their independent ratings of relative aptitude requirements.

For the six common career ladders, the contractor and in-house studies produced essentially equivalent results. Therefore, the two studies were merged, yielding relative aptitude requirement levels for all tasks in 14 career ladders. These aptitude requirement indexes were applied to occupational survey data in the 14 career ladders, and relative aptitude requirement levels were computed for every position in each of these ladders. For reasons which are too complicated and numerous to discuss in this presentation, the individual position requirements were based upon the "average requirement level of tasks performed per unit time." The CODAP system was then used to compute the mean, distributions, and standard deviations for first-termer jobs in each ladder, as well as for each job-type in each ladder.

The primary results of the completed study are shown in Figure 4. The data in Figure 4 gives consideration to the difficulty level of every task in thousands of individual first-termer jobs. For each ladder, the horizontal line reflects the relative aptitude requirement levels for first-term jobs falling minus one and plus one Standard Deviation around the Mean. That is, the bars show the aptitude requirement levels for approximately the middle 68% of jobs in each ladder. The left hand column in this Figure indicates the current aptitude requirement levels for the 14 ladders. The vertical lines, representing estimated AQE equivalents, have been drawn arbitrarily, and are designed to assist in evaluating the relative aptitude requirements.

If the Air Force cannot fill quotas at the 80th centile level, it would appear that requirements could be lowered to 70 in both the Information and Weather career ladders. Under more severe pressures, the Accounting and Disbursement requirements could be dropped from 80 to 70. The actual aptitude requirements for all four of these ladders appear to be less than they are for the Procurement ladder; yet the current stated requirement for the Procurement ladder is only at the 70th centile level.

At the 60 level, the Air Force should be able to drop the requirement for the Communications Center ladder to 50 and the Medical Material ladder all the way down to 40. In the face of drastic shortages, consideration could be given to dropping the requirement for the Administrative Ladder to 30. Even if we do not run into problems in filling quotas, the data in this figure could be used to make certain adjustments which would bring ladders into proper alignment.

Most career ladders in the Air Force contain more than one type of job. For example in the Disbursement Accounting ladder, some individuals spend

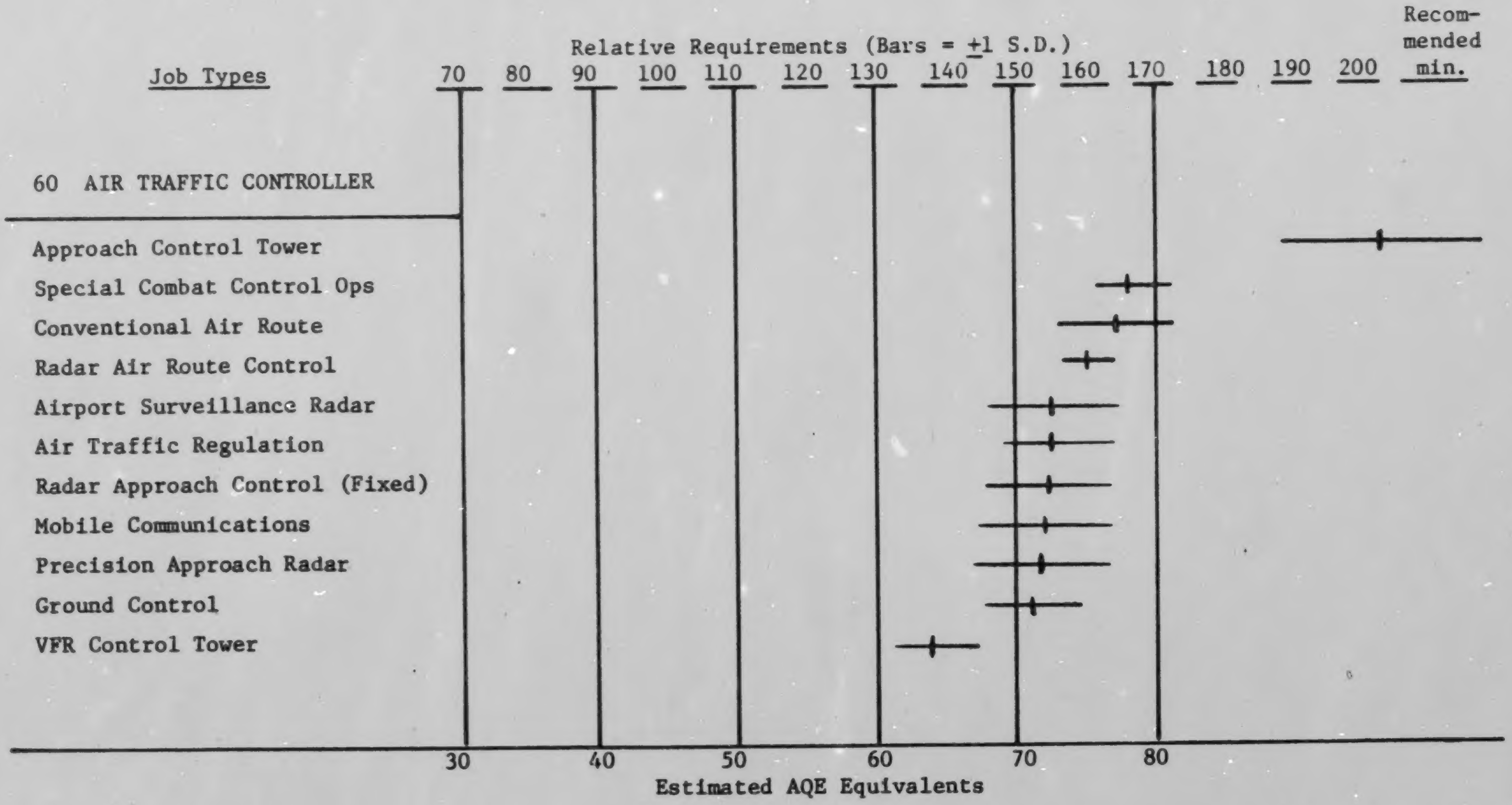

Figure 5. Relative Aptitude Requirements for 1st-Termer Jobs

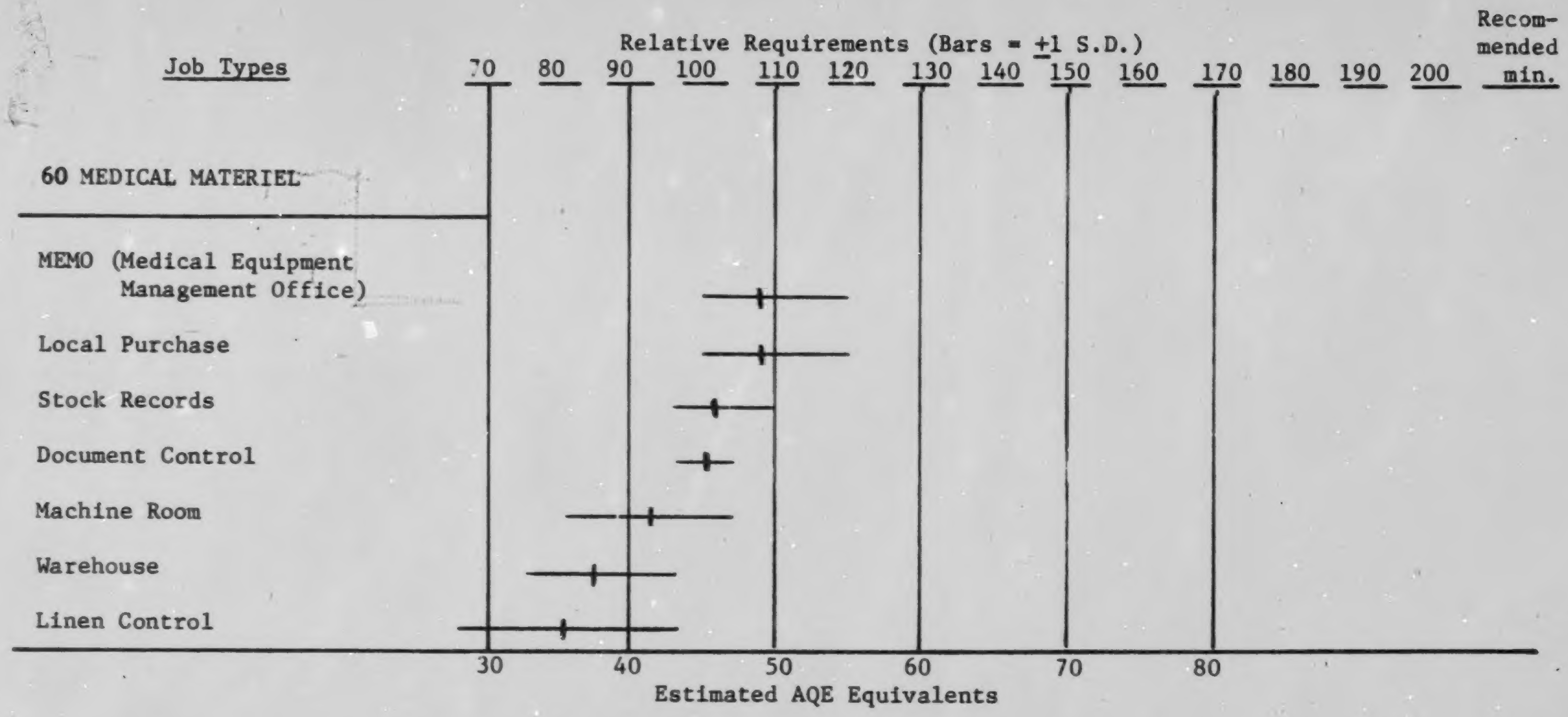

Figure 6. Relative Aptitude Requirements for 1st-Termer Jobs

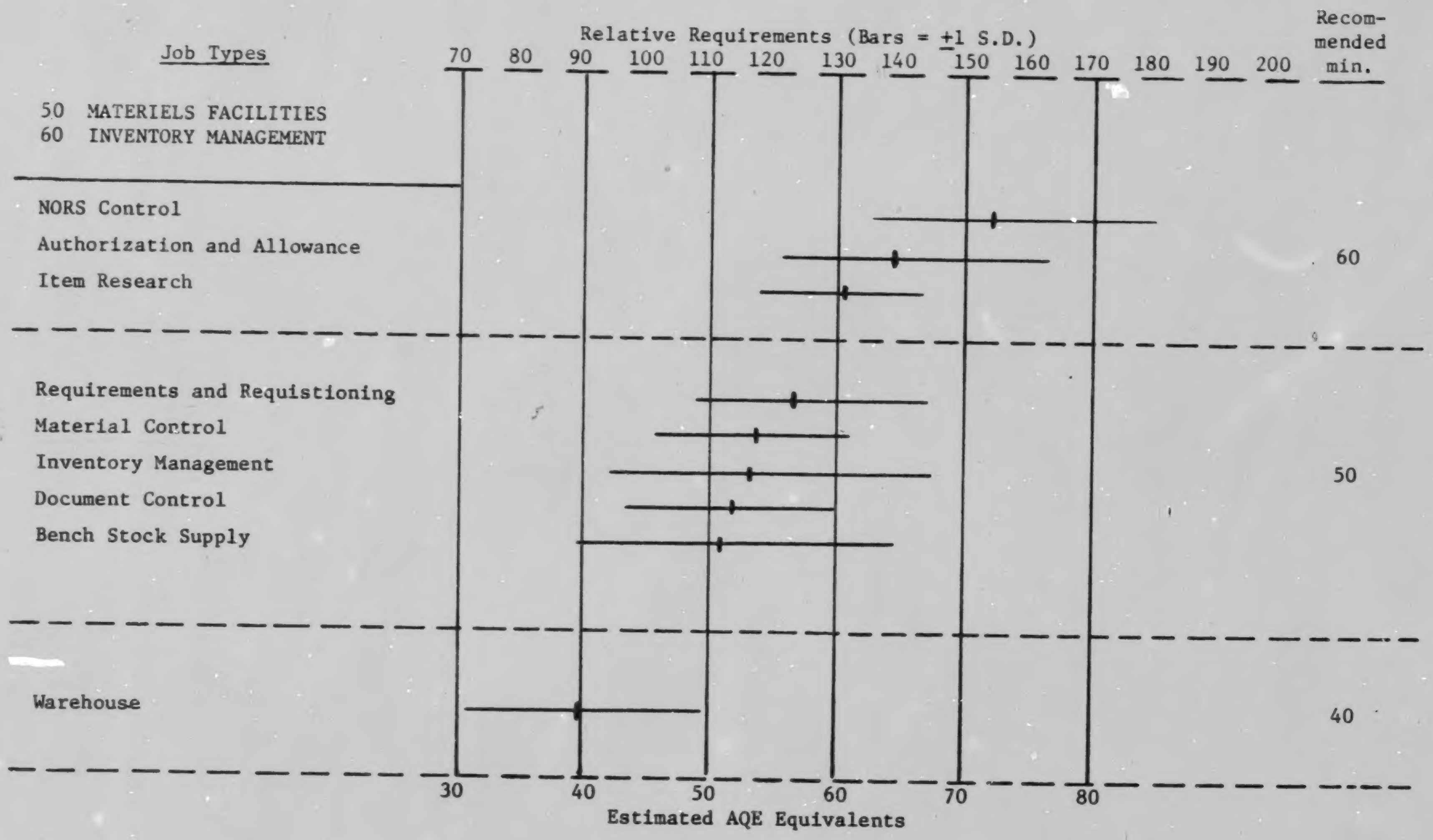

Figure 7. Relative Aptitude Requirements for 1st-Termer Jobs

full time computing travel vouchers, some keeping manual military pay records; some operating military pay computers; some paying and collecting cash; and so on. The CODAP system includes programs for identifying and defining the job types in each ladder. One type of contingency plan which could be implemented in an emergency is to shred out certain job types within ladders which can be performed by individuals with lower aptitudes. A few examples are shown in Figure 5, 6, and 7.

So far, two types of contingency plans have been described. One involved identifying career ladders for which the aptitude requirements can be lowered with the least danger to mission accomplishment. The second involved identifying job types within existing ladders which can be separated out and made into new specialties for performance by individuals with less talent. A third type of plan involves removing simple tasks from existing jobs and engineering them into new jobs for performance by individuals with less talent. The CODAP analysis system will compute the amount of work time being spent by every individual in a career ladder on such easy tasks. Other CODAP programs can provide summary tables indicating the amount of time spent on low-level tasks by all individuals at various locations. If one proposed to re-engineer jobs, this would tell him where he might have the best chance of success.

Job Satisfaction Research

There is a great deal of research evidence in the civilian sector indicating that factors related to job content and job conditions influence the decisions of individuals to stay with or leave work situations. In the Air Force, factors related to job content, assignment location, and worker-supervisor interactions are among those frequently cited by individuals for their decisions to leave the service. As we have moved into a zero-draft environment, retention of qualified workers has become an extremely important goal. Such individuals are available in limited quantities, and they are difficult to enlist, expensive to train, and hard to replace. In recognition of this, the Air Force has recently placed increased emphasis on job satisfaction research. A full-time effort in this area was initiated a little over a year ago. Fortunately, data on two factors ("Job Interest" and "Utilization of Talents and Training") had already been collected in job inventories for over 130,000 workers in approximately 150 occupational areas. Detailed analyses of data on these two factors are currently underway, but a few observations have already been made (Gould, 1972). Extensive differences in expressed job satisfaction have been found to exist between career ladders and among individuals within career ladders. For example, in some ladders fewer than 5% of the workers report that their talents and training are not being utilized in their present work assignment; while in other career ladders, over 50% of the workers report their talents and training are being utilized "very little" or "not at all." We have conducted intensive studies in a few career ladders in which a large number of individuals report low interest and utilization, and found that in many instances there is ample justification for such feelings (Stacy, 1973).

So far, we have been able to account only for a modest portion of the variance in attitudes among individuals within career ladders. Tables 10 and 11 report the validities of certain predictors for the interest and utilization factors. The full model includes predictors such as job difficulty, grade, time-on-job, aptitude, education, command, unit and base size, and age. All of these variables in combination yielded Rs which are only of modest size (.29 - .47). The largest and most consistent relationships are associated with the difficulty level of the work assigned and the aptitude level of the worker. These relationships are not large; but they are significant and always in the same direction. The most satisfied workers tend to be those who have the lowest relative aptitude and who are assigned to the most difficult work. In these tables, the variable "Work Difficulty" represents a least-squares weighted combination of (a) the number of tasks performed, (b) the number of tasks performed (squared), (c) the Average Task Difficulty Per Unit Time, and (d) a complex variable which is the sum of the cross-products of time spent on each task and the average grade level of all personnel in the career ladder currently performing that task.

The long-term job satisfaction research program of the Occupational Research Division involves three phases. First, recognition that job satisfaction is multi-dimensional. We are attempting to isolate and define all significant job-related factors which should be included in our job satisfaction studies. Second, determination of the impact of each factor on career decisions. Finally, determination of how jobs and job conditions can be modified so that workers will look favorably on the Air Force as a career choice.

With respect to the first goal, we have developed a group of 330 attitude statements which we feel cover the satisfaction domain. These are being analyzed using a combination of cluster analysis, factor analysis, and regression analysis, with the goal of producing a minimum set of attitude measures which cover all important dimensions. Phase II will involve determining the impact of each attitude on the reenlistment decisions of workers in each career ladder. This turns out to be a very complex problem. In the civilian sector, one can simply administer a job attitude questionnaire to a sample of workers and, at a later point in time, relate the score values to a criterion of "1 if still on the job; 0 otherwise." In the military setting, jobs are constantly being modified, and individuals are frequently moved from one location to another. There is no easy way of continuously tracking each individual and measuring changes in job content, job conditions, and job attitudes over time. Furthermore, we don't know when each individual finalizes his decision to reenlist or get out of service.

We have developed a method, based on cross-sectional data, for inferring the probable impact of a particular job attitude on the reenlistment decisions of personnel in a particular career ladder. The model is made possible by the fact that all enlistments in the Air Force have been for a 48-month period. It involves construction of a regression

TABLE 10. PREDICTION OF REPORTED "UTILIZATION OF TALENTS AND TRAINING" BY FIRST-TERM AIRMEN

Career Ladder	N	Full[a] Model	Work[a] Difficulty	No. Tasks Performed	ATDPUT[b]	Avg AI
291	862	.44	.21	.21	-.03	-.20
473	720	.36	.28	.21	.18	-.03
543	470	.40	.22	.21	.07	-.21
551	836	.45	.32	.28	.30	-.11
605	814	.43	.27	.23	.20	-.16
631	876	.36	.19	.07	.15	-.20
645	1,568	.34	.10	.05	.06	-.18
647	1,470	.34	.14	.11	.12	-.14
702	2,452	.35	.22	.20	.09	-.18
571	1,214	.29	.14	.07	.13	-.15
811	2,644	.32	.22	.15	.21	-.10

---

[a] See text for definition

[b] Average Task Difficulty per Unit Time

TABLE 11. PREDICTION OF REPORTED "JOB INTEREST" BY FIRST-TERM AIRMEN

Career Ladder	N	Full[a] Model	Work[a] Difficulty	No. Tasks Performed	ATDPUT[b]	Avg AI
291	862	.38	.18	.16	.00	-.14
473	720	.40	.26	.15	.22	-.03
543	470	.34	.16	.15	.07	-.14
551	836	.47	.28	.25	.23	-.02
605	814	.41	.28	.21	.22	-.13
631	876	.40	.24	.06	.20	-.16
645	1,568	.30	.11	.10	.04	-.06
647	1,470	.32	.16	.12	.13	-.03
702	2,452	.32	.18	.15	.09	-.08
571	1,214	.30	.19	.09	.18	-.02
811	2,644	.38	.29	.19	.27	-.06

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[a] See text for definition

[b] Average Task Difficulty Per Unit Time

curve which predicts the attitude of individuals still on board at each month of military service. In order to afford some protection against the problems of interpreting cross-sectional data in a longitudinal manner, aptitude is held constant, and the regression line is drawn for those at the mean aptitude level.

- To be more precise, assume that we are predicting the job interest level for a particular group. The predictors included in the equation would be as follows:

X_1 = Months of Service (continuous)

$X_2 = 1$ if $X_1 = 0\text{-}48$; 0 otherwise

$X_3 = 1$ if $X_1 > 48$; 0 otherwise

$X_4 = X_1$ if $X_2 = 1$; 0 otherwise (or X_1X_2)

$X_5 = X_4^2$

$X_6 = X_1$ if $X_3 = 1$; 0 otherwise (or X_1X_3)

$X_7 = X_6^2$

X_8 = Average Aptitude Index on the AQE

Note that the regression weights associated X_2, X_4, and X_5 will have an impact only with respect to individuals in their first enlistment. The weights associated with X_3, X_6 and X_7 will impact only upon individuals who have elected to reenlist in the Air Force, and who are now beyond the 48th month of service.

The upper left curve in Figure 8 presents a regression curve for a subsample of nearly 8,000 cases drawn at random from 130 Air Force career ladders. Interpreting this curve in a longitudinal manner, it appears that Air Force personnel have a slight decline in job interest during their first enlistment. The jump in the curve between the 48th and 49th month of service is hypothesized to be a function of residualization. That is, those who found their jobs dull tended to get out in greater numbers than those who found their jobs interesting. One might assume that the jump in the curve simply reflects a change in attitude by individuals after they decided to reenlist; but this assumption is weakened by the observation that little or no jump occurs in the regression curves for many ladders. Regression curves for other ladders are shown in Figures 9, 10, and 11. Where little difference is found between the level of the regression curve at the 48th and 49th month, it is assumed that efforts to make jobs more interesting may have very little impact on retention. Such is the case for the 687X0, Programmer, where individuals who left the service evidently were finding their jobs as interesting as those who reenlisted. Perhaps some other factor, such as

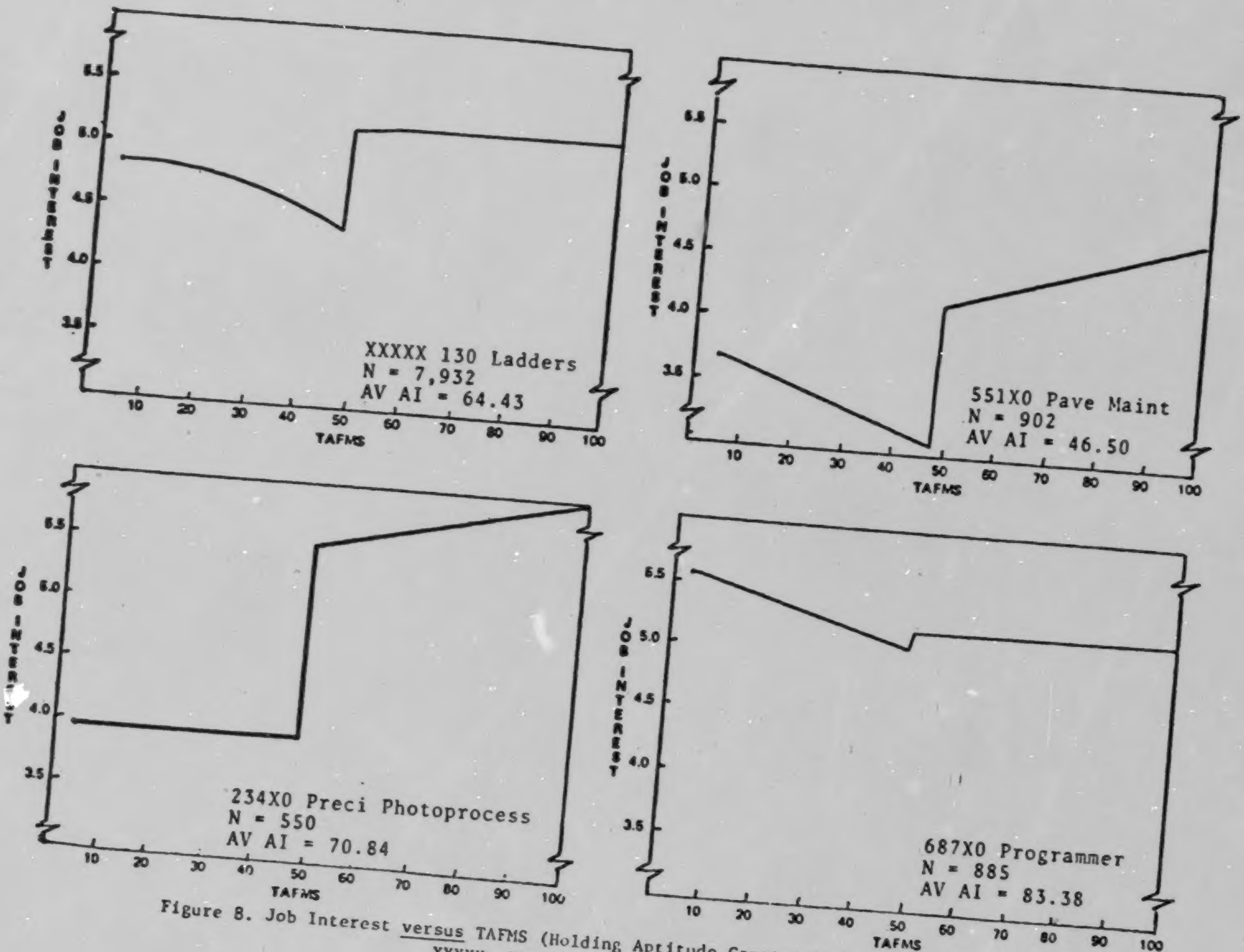

Figure 8. Job Interest versus TAFMS (Holding Aptitude Constant) for Career Fields XXXXX, 551X0, 234X0, and 687X0

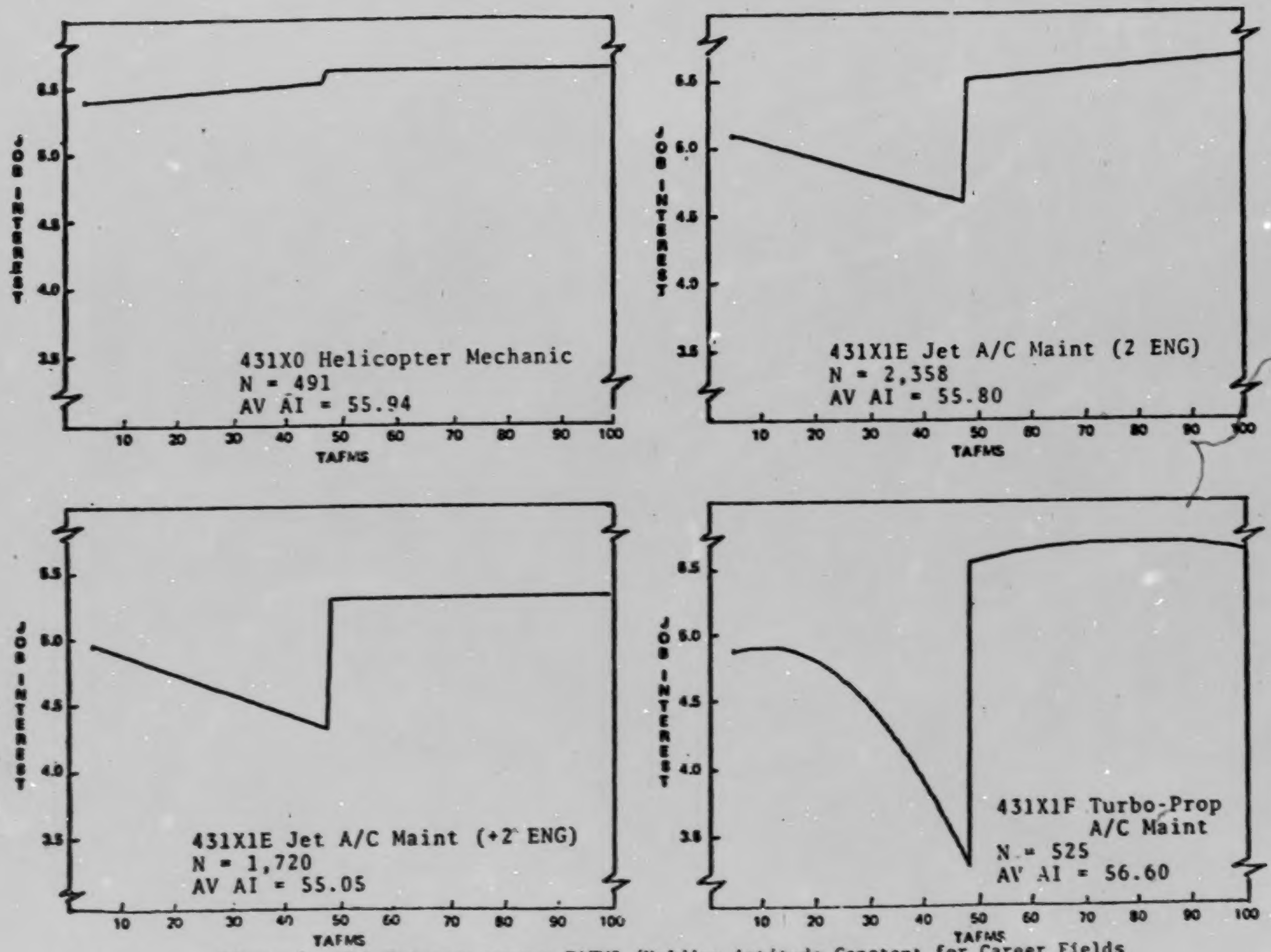

Figure 9. Job Interest *versus* TAFMS (Holding Aptitude Constant for Career Fields 431X0, 431X1E, 431X1E, and 431X1F

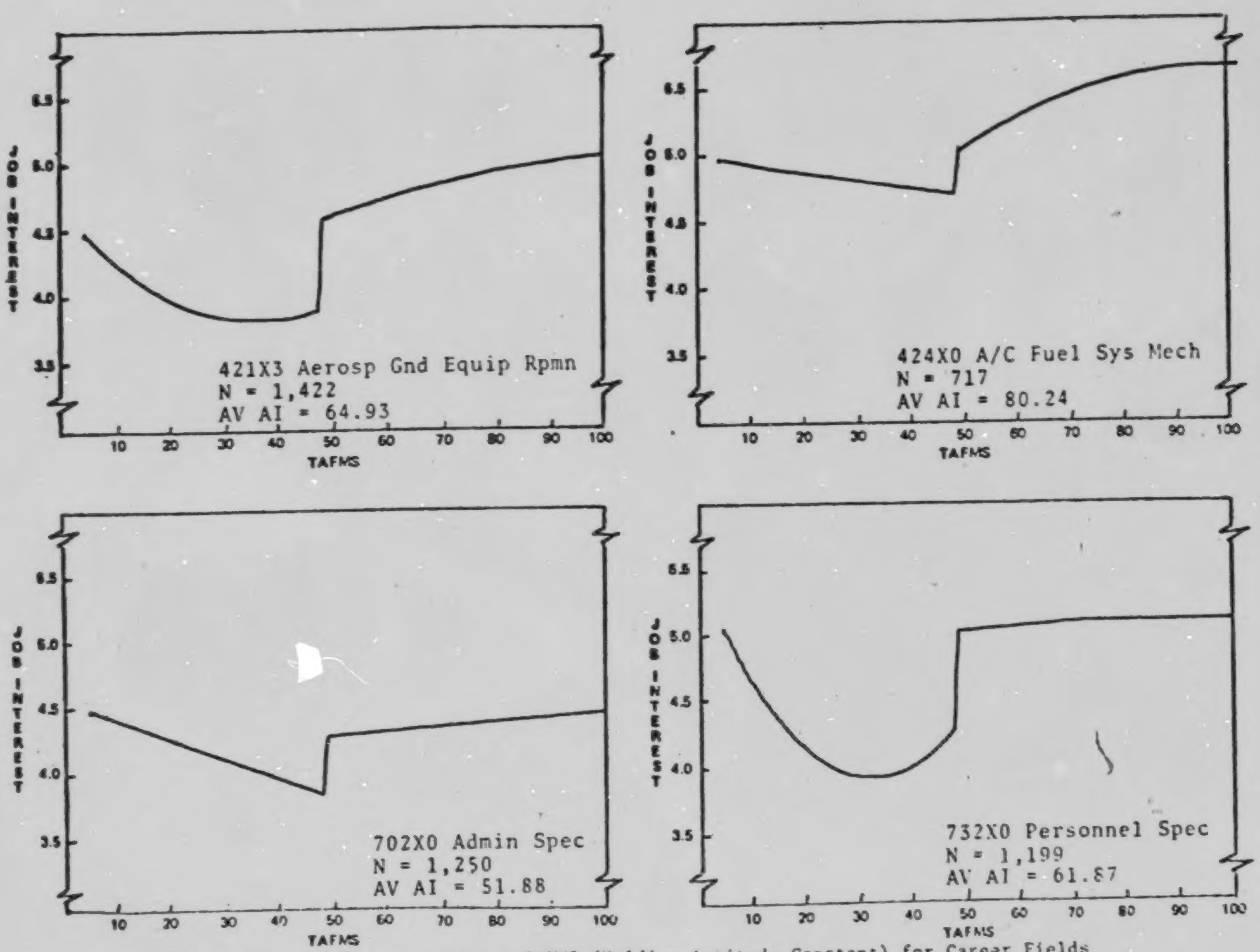

Figure 10. Job Interest *versus* TAFMS (Holding Aptitude Constant) for Career Fields 421X3, 424X0, 702X0, and 732X0

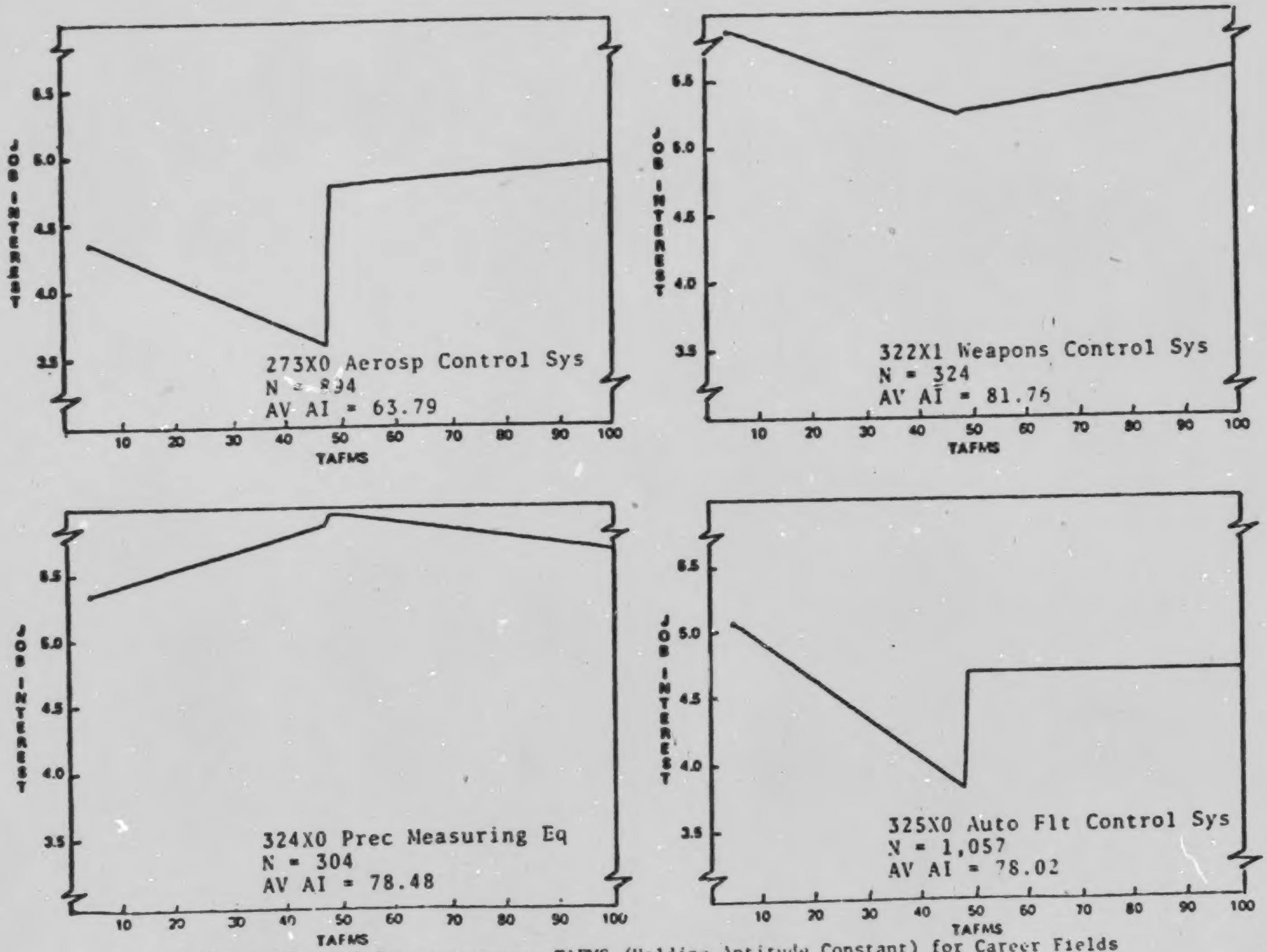

Figure 11. Job Interest versus TAFMS (Holding Aptitude Constant) for Career Fields 273X0, 322X1, 324X0, and 325X0

"pay in service compared with expected pay in comparable civilian jobs" would demonstrate a larger "impact gap." If so, the service might better improve retention by special pay benefits, or by educating workers concerning the reality of pay differentials.

Hopefully, we will eventually come up with more direct measures of the impact of job attitudes on retention. In the meantime, regression analyses, such as those described above, will provide clues as to what factors may influence career decisions in each ladder.

The third phase of the job satisfaction program, which is the most exciting, will be an attempt to find out what changes in jobs and job conditions will produce positive changes in those attitudes which influence reenlistment decisions. Here the military services are in an ideal position to provide answers. Since jobs and job conditions are frequently changing, we can conduct Time 1 - Time 2 studies in which we simply relate changes in jobs and job conditions to changes in expressed attitudes.

Of course we recognize that changing jobs and job conditions is not the only approach to enhancing job satisfaction. Proper selection and classification actions can contribute toward future job satisfaction. This is not a neglected area of research, but time is not sufficient enough to discuss it here. Nor can the various theories of job satisfaction and this relationship to our research be discussed. An excellent paper on the implications of theories for Air Force job satisfaction research is currently in press (Tuttle & Hazel, 1973).

As mentioned earlier, factors related to job content, assignment preference, and worker-supervisor interactions are among those frequently cited by personnel for their decisions to leave the Air Force. We are currently conducting an extensive study of the preferences of individuals for assignment locations. I can report that most individuals express very strong positive and negative valences for particular assignment locations. If the services cannot assign individuals to their most preferred location, perhaps they can at least avoid assigning them to locations for which they have a strong negative valence.

The matter of supverisor-worker relationships is multi-faceted, and we will study each facet separately. One matter which should be of concern to all services is that of supervisory incompetency. We have evidence that occupational structures and personnel assignment practices can create situations where first-line supervisors have had no direct experience on critical tasks being performed by their subordinates. There is a particular danger of this occurring in complex career ladders involving numerous job types or having varied equipments to maintain.

SUMMARY AND CLOSING REMARKS

Recommendations, based upon experience, which I would make to any organization planning a large-scale job analysis system based on administration of task-level job inventories are:

1. Use full-time inventory writers to develop task lists and background questions.

2. Write specific task statements, rather than broad task statements.

3. Include any background items which might answer questions asked by managers of the personnel system.

4. Collect worker name and identification information.

5. Administer inventories to large samples.

6. Collect data on optical scanning sheets.

7. Use a "relative time spent" scale as the primary rating factor, and convert ratings into percent time estimates.

8. By all means, obtain and use the CODAP system if at all possible. You can modify it to your needs, but it will be expensive and time consuming to build your own analysis system.

9. Establish an occupational research group to develop applications of occupational data in your military service or organization.

Thank you for the opportunity to participate in this symposium.

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APPENDIX

The following pages present a brief description of selected CODAP programs, along with example printouts produced by the CODAP system, as follows:

1. The first four pages of a seven-page Consolidated Job Description.

2. An Abbreviated Job Difference Description.

3. A sample Individual Job Description.

Appendix

DESCRIPTION OF SELECTED CODAP PROGRAMS

CODAP: COMPREHENSIVE OCCUPATIONAL DATA ANALYSIS PROGRAMS

CODAP is a computerized occupational data analysis system which inputs and performs calculations upon raw data from job inventories. It is designed to furnish users with a wide variety of reports that facilitate the identification of individual and group job characteristics and the detection of between-job similarities and differences.

INPSTD: RAW DATA EDITING AND INPUT

This program reads task titles, task responses, and background data from tape or card input. It edits the data, converts the raw task responses to percentages, constructs data vectors for each case, reorganizes the data to a standard history data format, and writes the formatted data on the output tape for use in subsequent programs. INPSTD will accept a maximum of: 928 background and/or computed variables, 1000 task variables, 26 duty variables, 20,000 cases, and 927 non-zero task responses per case.

JOBDEC: CALCULATING COMPOSITE JOB DESCRIPTIONS

This program calculates and prints composite job descriptions for groups formed during the hierarchical grouping process (JOBGRP) or for special groups whose membership is defined in terms of some combination of background or computed variables (JOBSPC). Both duty and task job descriptions may be reported in high to low sequence of either "average percent time spent by all members" or "percent of members performing." (A duty is a functional area comprising a number of tasks and, hence, is a summary report.)

A job description produced through JOBDEC provides the following information: duty/task number, duty/task title, percent of members performing each duty/task, average percent time spent by members performing, average percent time spent by all members, and cumulative average percent time spent by all members.

GRPSUM: SUMMARIZING JOB DESCRIPTIONS

This program calculates and prints a report of either the percent of members performing each task in the job inventory or the average percent time spent on each task by all members for any number of groups whose composite job descriptions were computed by JOBDEC or JOBSPC. The summarized data is printed in task number order and the group descriptions are ordered according to the sequence of the input request cards. GRPSUM does not print task titles, as does PRIJOB, nor does it have PRIJOB's facility to specify criteria for excluding tasks from the summary report.

GPSUM: SUMMARIZING JOB DESCRIPTIONS (FORMAT 2)

This program is a version of GRPSUM containing certain features adapted from PRIJOB. Like GRPSUM, GPSUM2 calculates and prints a report in duty/task order of either the percent of members performing each task in the job inventory or the average percent of time spent on each task by all members of groups whose composite job desciptions were computed by JOBDEC or JOBSPC. Whereas, GRPSUM prints no task statements and carries all percentages to three decimal places, GPSUM2 does print task statements and rounds off all percentages to whole numbers.

PRIJOB: CALCULATING PRIMARY JOB IDENTIFIERS

This program calculates and prints a report of those tasks which are determined to be "primary identifiers" of job types. Primary identifiers may be defined as the top x-number of tasks in a group job description in terms of percent of members performing or average percent time spent by all members. Primary identifiers may also be defined as those tasks performed by a specified minimum percentage of the group members or which exceed a specified average percent time spent value. This program allows a number of groups to be aligned in a single report for comparative purposes.

JOBIND AND INDJOB: CALCULATING INDIVIDUAL JOB DESCRIPTIONS

The JOBIND program calculates and prints job descriptions for individual cases. Both duty and task descriptions may be reported. Output will be task statements sequenced from high to low percent time spent, together with their percent time spent values and cumulative percentages. Selected background information may also be printed at the top of each description. JOBIND has six options for selecting cases: (1) by last two digits of service number; (2) by every Nth case beginning with a specified KPATH sequence number; (3) by meeting specified requirements on one to nine background variables; (4) by membership in a specified job type group; (5) by case control number; (6) randomly, using a random number generator. The selected descriptions may be sorted in KPATH order, in random order, by background variables, or in case control number order. The six options for selecting cases may also be used to create new categorical membership variables which are inserted in the variable dictionary as computed variables.

The INDJOB program also calculates and prints individual job descriptions, but prints only task identification numbers and percent time spent values for duties or tasks in duty/task sequence. A single report prints information for all cases in a columnar format. There are only three options for selecting cases: (1) by case control number; (2) by meeting specified requirements on one to nine background variables; (3) by membership in a specified job type group. INDJOB has no sort options.

GRPDIF: DIFFERENCE COMPARISON BETWEEN JOB DESCRIPTIONS

This program calculates and reports the difference between two job descriptions in terms of percentage of members performing each task and/or average percent time spent. Difference values are presented in ascending or descending order on either value (from largest negative to largest positive difference or vice versa) or in task number order.

AUTOJT: AUTOMATED JOB TYPE SELECTION PROGRAM

This program calculates, evaluates, and reports between-group differences for specified pairs of groups whose job descriptions were computed by JOBDEC or JOBSPC. Six comparison options are used: (1) differences in average percent time spent on each task; (2) differences in average percent time spent on each duty; (3) differences in percentage of members performing each task; (4) differences in number of tasks accounting for a major portion of average percent time spent; (5) differences in number of duties accounting for a major portion of average percent time spent; (6) differences in average number of tasks performed. As many as 850 pairs of groups can be compared in one run of AUTOJT.

VARSUM: SUMMARIZING BACKGROUND AND COMPUTED VARIABLES

This program computes and reports frequency distributions within specified intervals, makes total frequency counts, and calculates means and standard deviations on selected background and computed variables for any group of individuals whose job description has been generated by JOBDEC or JOBSPC. VARSUM can process data on as many as 20,000 cases.

DIST2X: COMPUTING A TWO-WAY DISTRIBUTION

This program distributes a group of individuals on two variables (a row variable and a column variable). The group distributed may be the total sample or the cases coded "1" or "0" on a categorical membership variable. The row and column variables may be alpha or numeric, and intervals of unequal width may be defined for any variable. The data presented may be frequencies within cells or frequencies and percentages within cells. The percentages are computed based on individual row frequency totals, or on individual column frequency totals, or on the total N for all rows and columns. Any or all three sets of percentages may be displayed in the two-way table. A "total" category for rows and a "total" category for columns is automatically included for percentages and/or frequencies. The total number of cases counted and the total number of valid cases are given for each row and column and for total rows and total columns. Valid cases include all distributed numeric data. Only valid cases are used in the computation of means and standard deviations. Optionally, an "other" category may be included for rows and columns. Inclusion of the "other" category causes all numeric data to be counted as valid. Another option provides for the computation of means and standard deviations for individual rows and total rows and/or individual columns and total columns. Only cases defined as valid are used in computing means and standard deviations. A summary of selected information appears at the end of the report. Any number of reports may be generated in one program execution.

AVALUE: CALCULATING AVERAGE VALUE

For each task in a job inventory, this program calculates and prints the mean and standard deviation of a selected background or computed variables, using all valid responses of individuals in a specified group who perform the task. Task titles and the number of valid respondents on each task are also reported. Average values are optionally sequenced from low-to-high average value, high-to-low average value, or in task number order. Tasks with fewer than x-number of valid respondents may be removed from the main report to a supplementary report. AVALUE can be calculated for any group of individuals who can be identified on some range of a background or computed variable or by the intersection of up to nine variables.

TSKNDX: CALCULATING AVERAGE TASK RATINGS

This program has the same options as AVALUE, except that it is used with task ratings rather than with background or computed variables. TSKNDX can also provide the following additional task information not available in AVALUE: (1) percent of members performing; (2) average percent time spent by members performing; (3) average percent time spent by all group members; (4) cumulative sum of average percent time spent by all group members. TSKNDX is primarily used to compute average task difficulty ratings.

RXXNDX: COMPUTING INTERRATER RELIABILITY

This program computes and reports for a group of raters the average interrater reliability coefficient of a single rater and the stepped up reliability coefficient for the total group of raters. The program is most often used in conjunction with sets of task difficulty ratings made by a large number of supervisory personnel.

TSKDST: DISTRIBUTING MEANS AND STANDARD DEVIATIONS OF TASK RATINGS

This program computes and reports the distribution, mean, and standard deviation of the mean task ratings and the standard deviations of the ratings for each task. The input to TSKDST is the punched output furnished by TSKNDX.

ASFACT: REPORTING SECONDARY FACTOR DATA

If the tasks in a job inventory are rated on a second scale such as "amount of training required," the data is handled through the ASFACT program. The ASFACT program reports the following information on each task for any group of individuals whose job description has been computed by JOBDEC or JOBSPC: (1) frequency distribution of members responding on the secondary factor (0 to 9 scale); (2) total number of respondents; (3) number of respondents with values outside the specified range; (4) arithmetic mean and standard deviation of acceptable responses.

VARGEN: COMPUTING NEW VARIABLES

This program calculates new computed variables by applying input data to the task values of each case. The task values may be time spent percentages or "do - don't do" values (1,0). The input data consists of a vector of weights, a scaling (standardizing) factor and a specified calculation formula (five options). A newly created variable is given a variable identification number and is added into the computed variable portion of the case data records on the history data tape.

PREGEN: GENERATING NEW PREDICTORS

This program creates new computed or background variables for input to other CODAP programs, principally the correlation and regression program (CORREG) according to certain standardized options, as follows: the new variable can be the sum of two variables, the difference between two variables, the product of two variables, or the ratio of two variables. Each option allows for adding a constant if so desired. Variables may also be created by setting certain values of a variable out of range and then, either leaving these values unchanged during the generation of the new variable, or setting them equal to zero or to some constant. This option is most frequently used to enable the selection of a specific subsample of cases by creating a categorically coded membership variable representing in-range and out-of-range cases ("1" or "0," respectively). Variables created at an early point in the program run may be used to create additional variables at some later point. Up to 500 variables can be created in a single PREGEN run.

CORREG: CORRELATION AND REGRESSION PROGRAM

This program package extracts up to 100 computed and background variables from a CODAP KPATH or history data tape and computes correlation matrices and regression problems.

The correlation program computes and prints the correlation matrix, number of valid and invalid cases in the sample, and means and standard deviations of variables. These same computations are also put on tape for future reference, and they also remain in core if they are to be fed into the regression program immediately.

The regression program has two options. One option computes regression equations for various combinations of full and restricted models and evaluates the difference between full and restricted models with an F-test. The value and the probability of the computed F-ratio are reported.

The second option is designed as an aid to building an appropriate regression model. In this option, a series of regression problems is computed iteratively. Beginning with the best combination of three predictors at iteration 1, the best remaining combination of three predictors is added to the model at each subsequent iteration. The "best remaining combination" is that which adds the most to the value of R_2 when used in conjunction with all combinations of predictors selected at previous iterations. Predictors may be used more than once during the iterative process. Iterations are continued until the increase in the value of R_2 over the previous iteration is less than some amount specified by the requester. Variable ID's, R_2 values, and the error sum of squares are reported for each iteration. The standard and raw score weights for each variable as they exist upon completion of the final iteration are reported, as well as the regression constant.

Either one or both regression options may be requested at the same time.

OVRLAP: RELATING RESPONSES TO EACH OTHER

This program generates an overlap or similarity matrix of all possible paired comparisons between individual cases. Similarity is expressed as a percentage of common tasks performed (TSKOVL) or as the total overlapping percentage of time spent on tasks (TIMOVL). Overlap in terms of percent time spent is the preferred option in most studies. OVRLAP can handle up to 2,000 cases and 1,000 tasks.

GROUP: CLUSTERING INDIVIDUALS AND GROUPS OF INDIVIDUALS

This program uses the similarity matrix computed in the overlap (OVRLAP) program to form clusters of cases. The grouping technique, called "collapsing the matrix" or "hierarchical grouping," involves repeated searching for those individuals or partially formed clusters which have the highest (or lowest) remaining similarity, depending on whether a "maximizing" or "minimizing" process was requested. The "maximizing" option is always used for job survey data.

Each new clustering or "collapse" is called a "stage" and the vectors of similarity values for the clusters being merged are combined according to a specified mathematical algorithm to form an integrated cluster. Several formulas for combining groups are available. The collapsing process continues until a single group has formed which contains all cases in a study.

KPATH AND PRKPTH: ORDERING A HISTORY DATA TAPE AND PRINTING A HISTORY DATA REPORT

After OVRLAP and GROUP have been completed, the KPATH program assigns sequence numbers to individual cases in such a way that each pair of individuals or groups which are merged during the grouping process will have a contiguous block of KPATH sequence numbers.

PRKPTH enables the user to select variables and printout formats to produce a report of the case data values for the selected background and computed variables. The data to be printed is obtained from a history data tape which may be in case ID or KPATH order. The data is not sorted and therefore the output will be in case ID or KPATH order.

DUVARS: COMPUTING A DUTY VARIABLE FOR EACH CASE

This program uses task data to compute duty values for each case and displays the duty values in the form of a PRKPTH. Three duty variable options are available: (1) percent time spent in each duty by each case; (2) number of tasks performed in each duty by each case; (3) percent of tasks performed within each duty by each case as a function of his total number of tasks performed. This program is used principally as an aid in selecting meaningfully different job-type groups.

GRMBRS: REPORTING GROUP MEMBERSHIP

This program produces an information report that identifies the two groups combining at each stage of the hierarchical grouping process. The information includes the stage number, the number of members in the combined group, the number of members in each of the combining groups, range of KPATH sequence numbers for the combining groups, the average percentage of overlap between the members of the combining groups, and the average percentage of overlap within the combined group.

DIAGRM: GRAPHICAL PRESENTATION OF HIERARCHICAL GROUPING ACTIONS

This program uses data from the GRMBRS program to generate a treelike diagram that visually displays the order in which groups merged during the hierarchical grouping process. Each group is represented by a rectangular block of data containing the same information found in GRMBRS. Rows and columns of asterisks show the branches leading from a group to its subgroups. Control cards can be used to limit the number and type of groups displayed by DIAGRM.

MBROVL: OVERLAPPING INDIVIDUAL JOB DESCRIPTIONS WITH A COMPOSITE JOB DESCRIPTION

This program computes the overlap of individual job descriptions with the composite job description for the group and reports the individual overlap values, their mean and standard deviation, and an array of selected background data for each case. The format of the report is similar to PRKPTH, except that the cases are sequenced from highest to lowest overlap with the composite job description and only cases that are members of the selected group are included. Reports on a number of groups can be handled in one program execution. This program is useful in studying the homogeneity of membership in a group whose composite job description was computed by JOBDEC or JOBSPC.

MTXPR1: PRINTING AN OVERLAPPED MATRIX

This program calls for the subroutine OVRLAP to overlap all possible pairings of a set of composite (group) job descriptions and then uses the program MTXPRT to print the between-group overlap values in matrix form. Overlap may be computed in terms of average percent time spent on tasks or in terms of number of tasks performed in common. The maximum number of groups that can be input to MTXPR1 is 100.

JD2HDT: ADDING JOB DESCRIPTIONS TO HISTORY DATA TAPE

This program adds average job descriptions for groups to a history data tape as additional cases. Each of the new composite cases is given the next sequential case control number.

PRDICT: PRINTING DICTIONARY OF VARIABLE TITLES

This program prints a report containing the identification codes and descriptive titles of all background and computed variables peculiar to a particular study. The identification codes are used in calling for data to be reported by the PRKPTH and VARSUM programs, or to be acted upon by the VARGEN, PREGEN, PROGEN, JOBIND, AVALUE, or TSKNDX programs.

JOBINV: PRINTING OF DUTY AND TASK TITLES

This program prints a listing of the duty and task titles included in a job inventory. The titles are listed in task number sequence within each duty, and the format calls for two columns per page.

BCDEXT: REORDERING AND EXTRACTING REPORTS FROM THE BCD REPORT TAPE

All reports generated by CODAP can optionally be placed on a BCD output tape for future recall. The BCDEXT program extracts reports selected by control cards from the BCD file, prints them out in the same order as the input requests with continuous page numbering, and furnishes a table of contents with page number references.

PROGEN: PROGRAM GENERATION PROGRAM

This program permits the CODAP expert to add, extract, and manipulate data in the CODAP system in ways not encompassed by the standard CODAP programs and do so with a minimum amount of additional programming and without requiring thorough indoctrination in the CODAP system. PROGEN uses a combination of FORTRAN statements and shorthand operation codes to generate a special purpose program to read the KPATH or history data tape, either of which contains the entire data file for each case, and perform operations upon it. New variables can thereby be created and added to the CODAP variable dictionary. This program also has the facility to reconvert percent time task values for each case to the original raw response form, perform operations on the raw responses, and convert them back to percentages.

Appendix (Continued)

TASK JOB DESCRIPTION FOR JOURNEYMEN MEDICAL LABORATORY SPECIALISTS (N=394)

D-TSK		TASK TITLE	PERCENT OF MEMBERS PERFORMING	AVERAGE PERCENT TIME SPENT BY MEMBERS PERFORMING	AVERAGE PERCENT TIME SPENT BY ALL MEMBERS	CUMULATIVE SUM OF AVERAGE PERCENT TIME SPENT BY ALL MEMBERS
F	18	Collect Blood Specimens Directly from Patients	93.40	1.70	1.58	1.58
J	3	Perform Blood Count	89.09	1.56	1.39	2.98
J	17	Perform Hematology Procedures for Differential Cell Counts	88.83	1.49	1.33	4.30
J	24	Perform Hematology Procedures for Hematocrit Tests	89.09	1.45	1.30	5.60
N	2	Examine Urine Specimens Microscopically	88.07	1.43	1.26	6.85
J	5	Prepare Blood Smears	89.85	1.39	1.25	8.10
F	10	Prepare and Process Specimens	87.56	1.39	1.22	9.32
N	9	Perform Urinalyses for Glucose Tests	87.82	1.38	1.21	10.53
N	15	Perform Urinalyses for Specific Gravity Tests	87.06	1.38	1.20	11.73
N	6	Perform Urinalyses for Albumin Tests	87.06	1.36	1.19	12.92
F	3	Clean Area and Equipment Aseptically	80.96	1.46	1.18	14.10
N	1	Examine Urine Specimens Macroscopically	87.82	1.32	1.16	15.26
J	6	Separate Serum from Blood	87.31	1.30	1.14	16.40
F	11	Prepare Reagents	93.40	1.19	1.11	17.51
J	2	Identify Morphological Variations of Blood Cells	88.07	1.21	1.06	18.57
M	4	Operate Spectro-Photometer	77.66	1.34	1.04	19.62
J	21	Perform Hematology Procedures for Erythrocyte Sedimentation Rate	87.56	1.19	1.04	20.65
K	7	Perform Serological Procedures for Cardiolipin Microflocculation	78.93	1.30	1.03	21.68
G	1	Examine Specimens Microscopically	86.04	1.18	1.01	22.69
G	2	Identify and Classify Pathogenic Bacteria	78.68	1.27	1.00	23.69
G	10	Prepare Culture Media	78.68	1.26	0.99	24.68
F	12	Prepare Solutions and Standards	86.55	1.09	0.94	25.62
M	25	Perform Biochemical Procedures for Liver Function Tests	78.93	1.18	0.93	26.55
M	27	Perform Biochemical Procedures for NPN and BUN Tests	79.95	1.16	0.93	27.48
G	11	Stain Bacteriological Smears	85.28	1.08	0.92	28.41
L	3	Crossmatch Blood	72.59	1.24	0.90	29.30
L	16	Test Blood for ABO Grouping and ABO Subgrouping	80.20	1.12	0.90	30.20
J	1	Identify Immature Blood Cells	86.29	1.04	0.89	31.09
I	2	Examine Specimens Microscopically	81.47	1.08	0.88	31.97
G	6	Perform Antibiotic Sensitivity Test	75.38	1.17	0.88	32.85
F	14	Prepare Specimens for Shipment	84.26	1.03	0.87	33.72
E	3	Log Incoming or Outgoing Specimens	71.83	1.16	0.83	34.55
L	18	Type Blood of Donors and Recipients	74.87	1.10	0.83	35.38
L	2	Centrifuge and Separate Serum from Clot	73.10	1.11	0.81	36.19
M	33	Perform Biochemical Procedures for Total Protein and A/G Ratio	75.13	1.06	0.79	36.99
L	17	Test Blood for RHO or DU Factors	76.14	1.04	0.79	37.78
L	8	Perform Direct and Indirect Coombs Tests	75.38	1.04	0.78	38.56

Appendix (Continued)

D-TSK		TASK TITLE	PERCENT OF MEMBERS PERFORMING	AVERAGE PERCENT TIME SPENT BY MEMBERS PERFORMING	AVERAGE PERCENT TIME SPENT BY ALL MEMBERS	CUMULATIVE SUM OF AVERAGE PERCENT TIME SPENT BY ALL MEMBERS
M	5	Prepare Reagents and Standards	75.38	1.01	0.76	39.32
J	27	Perform Hematology Procedures for Prothrombin Time	79.19	0.95	0.76	40.08
J	4	Perform Spinal Fluid Cell Counts	84.52	0.88	0.74	40.82
I	1	Examine Specimens Macroscopically	79.95	0.92	0.73	41.55
I	6	Identify Protozoans, Cestodes, Nematodes, or Trematodes	74.62	0.95	0.71	42.26
F	19	Collect Fecal or Urine Specimens Directly from Patients	52.79	1.33	0.70	42.96
J	28	Perform Hematology Procedures for Reticulocyte Count	84.26	0.82	0.69	43.65
N	8	Perform Urinalyses for Bile Tests	85.28	0.80	0.68	44.34
I	3	Perform Concentration and Flotation Techniques	72.84	0.93	0.68	45.02
J	13	Perform Hematology Procedures for Coagulation Times by Capillary Method	79.70	0.85	0.68	45.70
M	34	Perform Biochemical Procedures for Uric Acid Tests	70.81	0.96	0.68	46.37
N	3	Perform Kidney Function Tests	76.14	0.89	0.68	47.05
J	30	Perform Hematology Procedures for Thrombocyte Count	80.46	0.83	0.67	47.72
J	14	Perform Hematology Procedures for Coagulation Times by Lee-White Method	82.23	0.81	0.66	48.38
M	37	Utilize Methods for Colormetric Procedure	52.03	1.25	0.65	49.03
J	11	Perform Hematology Procedures for Cerebrospinal Fluid Count	80.96	0.80	0.65	49.68
M	32	Perform Biochemical Procedures for Total Cholesterol and Esters Tests	68.27	0.93	0.63	50.32
M	17	Perform Biochemical Procedures for Chlorides Tests	71.07	0.89	0.63	50.95
N	12	Perform Urinalyses for Occult Blood Tests	82.49	0.76	0.63	51.58
E	5	Maintain Files of Clinical Laboratory Requests	54.82	1.14	0.63	52.20
J	8	Perform Hematology Procedures for Bleeding Time, Duke Method	71.83	0.86	0.62	52.82
M	38	Utilize Methods for Electrolyte Determinations	61.68	1.00	0.61	53.43
J	20	Perform Hematology Procedures for Erythrocyte Indices	79.44	0.75	0.59	54.03
M	11	Perform Biochemical Procedures for Calcium and Phosphorus Tests	64.72	0.92	0.59	54.62
E	7	Maintain Files of Laboratory Records or Reports	51.27	1.14	0.59	55.20
J	25	Perform Hematology Procedures for L. E. Test	75.38	0.77	0.58	55.79
L	5	Draw Blood for Transfusions	64.47	0.90	0.58	56.36
K	13	Perform Serological Procedures for Heterophile Presumptive and Differential Antibody Test	63.45	0.90	0.57	56.94
J	18	Perform Hematology Procedures for Eosinophile Count	80.46	0.71	0.57	57.51
M	2	Operate Flame Photometer	64.97	0.88	0.57	58.08
G	8	Perform Sperm Counts	79.44	0.71	0.57	58.65
J	29	Perform Hematology Procedures for Sickle Cell Preparations	82.74	0.68	0.56	59.21
M	14	Perform Biochemical Procedures for Carbon Dioxide Determinations	67.26	0.83	0.56	59.77
E	11	Receive Incoming Supplies	55.58	0.96	0.53	60.31
L	15	Store Blood According to Grouping and Factor	59.90	0.89	0.53	60.84
F	20	Collect Pus Specimens Directly from Patients	65.99	0.80	0.53	61.37
N	20	Perform Urinalyses for Urobilinogin Tests	75.89	0.66	0.50	61.87
K	14	Perform Serological Procedures for Latex Fixation Test	59.64	0.84	0.50	62.37
K	6	Perform Serological Procedures for "C" Reactive Protein Tests	61.42	0.80	0.49	62.86
H	4	Perform KOH Preparation for Dermatophyte	68.02	0.72	0.49	63.35

Appendix (Continued)

D-TSK	TASK TITLE	PERCENT OF MEMBERS PERFORMING	AVERAGE PERCENT TIME SPENT BY MEMBERS PERFORMING	AVERAGE PERCENT TIME SPENT BY ALL MEMBERS	CUMULATIVE SUM OF AVERAGE PERCENT TIME SPENT BY ALL MEMBERS
A 10	Develop and Improve Work Methods and Procedures	53.55	0.91	0.49	63.84
I 4	Dispose of Blood After Time Limit	62.18	0.77	0.48	64.32
M 8	Perform Biochemical Procedures for Blood Alcohol Tests	66.75	0.71	0.48	64.79
M 20	Perform Biochemical Procedures for Creatinine Tests	61.42	0.76	0.47	65.26
I 6	Maintain Donor Files	58.63	0.79	0.47	65.73
N 10	Perform Urinalyses for KETONE Studies	55.33	0.84	0.46	66.19
H 2	Examine Specimens Microscopically	60.15	0.77	0.46	66.65
J 12	Perform Hematology Procedures for Clot Retraction Test	73.35	0.63	0.46	67.11
A 5	Assure the Availability of Equipment and Supplies	42.64	1.06	0.45	67.57
A 26	Requisition Supplies and Equipment	44.67	1.01	0.45	68.02
F 12	Requisition Supplies	44.42	1.00	0.45	68.46
N 16	Perform Urinalyses for Total Protein	63.45	0.70	0.44	68.90
M 21	Perform Biochemical Procedures for Enzyme Analyses	46.70	0.95	0.44	69.35
M 42	Utilize Methods for Titrimetric Procedure	55.33	0.80	0.44	69.79
M 13	Perform Biochemical Procedures for Carbohydrates Tolerance Tests	44.67	0.98	0.44	70.23
H 5	Prepare Culture Media	57.87	0.76	0.44	70.67
H 1	Cultivate Mycology Specimens for Primary Isolation	56.09	0.77	0.43	71.10
D 6	Give On-The-Job Instruction in Medical Laboratory Activities	40.10	1.04	0.42	71.51
N 7	Perform Urinalyses for Bence-Jones Protein Tests	68.78	0.60	0.41	71.93
I 5	Stain Parasitological Smears	53.81	0.77	0.41	72.34
F 22	Collect Skin Specimens Directly from Patients	58.12	0.71	0.41	72.75
K 8	Perform Serological Procedures for Cold Agglutinations	57.11	0.72	0.41	73.16
N 4	Perform Pregnancy Tests	48.48	0.84	0.41	73.57
C 6	Evaluate the Accuracy of Routine Reports	39.09	1.04	0.41	73.98
K 5	Perform Serological Procedures for Antistreptolysin "O" Titers	48.48	0.82	0.40	74.37
L 13	Record Information on Blood Record Card	53.05	0.74	0.39	74.77
I 7	Maintain Files of Blood Banking Forms	53.30	0.74	0.39	75.16
F 9	Perform Preventive Maintenance on Laboratory Equipment	47.72	0.82	0.39	75.55
F 24	Collect Sputum Specimens Directly from Patients	52.28	0.72	0.38	75.93
L 1	Attach Serial Numbers to Units	48.22	0.78	0.38	76.30
M 1	Calibrate Instruments	52.03	0.72	0.37	76.68
L 14	Screen and Schedule Donors	50.51	0.72	0.36	77.04
N 5	Perform Urinalyses for Addis Counts	63.96	0.56	0.36	77.40
C 1	Determine Equipment Repairs or Replacements Needed	47.21	0.76	0.36	77.76
O 9	Prepare Specimens for Shipment	39.85	0.89	0.36	78.12
L 11	Prepare Blood for Shipment	46.70	0.72	0.34	78.46
M 40	Utilize Methods for Gasometric Procedure	41.37	0.81	0.34	78.79
K 11	Perform Serological Procedures for Febrile Agglutinations	45.69	0.72	0.33	79.12
A 21	Plan Reports for the Section	32.99	0.99	0.33	79.45
F 4	Maintain and Revise Stock Levels	35.53	0.92	0.33	79.77
A 20	Plan Record Keeping for the Section	30.71	1.06	0.33	80.10

Appendix (Continued)

D-TSK		TASK TITLE	PERCENT OF MEMBERS PERFORMING	AVERAGE PERCENT TIME SPENT BY MEMBERS PERFORMING	AVERAGE PERCENT TIME SPENT BY ALL MEMBERS	CUMULATIVE SUM OF AVERAGE PERCENT TIME SPENT BY ALL MEMBERS
J	19	Perform Hematology Procedures for Erythrocyte Fragility Tests	59.14	0.55	0.32	80.42
M	30	Perform Biochemical Procedures for Serum Frog Test for Pregnancy	40.61	0.78	0.32	80.74
I	6	Perform Bacteriological or Chemical Examinations of Water	41.37	0.74	0.31	81.05
H	6	Stain Mycology Specimens	48.22	0.62	0.30	81.34
N	17	Perform Urinalyses for Urinary Calcium	54.57	0.54	0.30	81.64
N	14	Perform Urinalyses for Porphyrins Tests	54.57	0.54	0.30	81.94
G	3	Maintain Stock Cultures	35.79	0.82	0.29	82.23
C	7	Evaluate the Adequacy of Routine Reports	29.44	0.98	0.29	82.52
O	15	Submit Tissue Specimens to AFIP or Histopathology Centers	32.99	0.87	0.29	82.81
A	7	Coordinate Work Activities with Other Sections	36.55	0.77	0.28	83.09
A	14	Establish Procedures for Special Tests	36.29	0.74	0.27	83.36
B	2	Direct Subordinates in Maintaining Performance Standards	30.96	0.87	0.27	83.63
I	10	Procure and Store Biological Items	35.53	0.75	0.27	83.89
H	3	Identify and Classify Fungi	36.04	0.73	0.26	84.16
O	2	Assist with Autopsy	39.34	0.66	0.26	84.42
I	4	Perform Bacteriological or Chemical Examinations of Food Products	40.86	0.63	0.26	84.67
L	9	Perform First Aid for Shock	51.02	0.49	0.25	84.92
K	2	Prepare Antigens	32.49	0.77	0.25	85.17
F	15	Prepare Specimens for Training or Refefence	36.29	0.67	0.24	85.42
N	13	Perform Urinalyses for Phenylpyruvic Acid Test	46.95	0.52	0.24	85.66
E	1	Supervise the Maintenance of Laboratory Supplies	23.60	1.02	0.24	85.90
B	5	Direct the Maintenance and Utilization of Equipment, Supplies and Work Space	27.92	0.86	0.24	86.14
A	3	Assign Specific Work to Individuals	30.96	0.78	0.24	86.38
C	18	Resolve Technical Problems of Subordinates	28.43	0.83	0.24	86.62
M	19	Perform Biochemical Procedures for Creatinine Clearance Tests	32.23	0.73	0.23	86.85
D	8	Indoctrinate Newly Assigned Personnel	35.28	0.67	0.23	87.09
C	14	Investigate Possible Sources of Staphylococcus Outbreaks	28.43	0.82	0.23	87.32
A	25	Plan Work Flow	25.13	0.92	0.23	87.56
C	9	Evaluate Work Performance of Subordinates	23.35	0.95	0.22	87.78
M	15	Perform Biochemical Procedures for Carbon Monoxide Determinations	39.09	0.57	0.22	88.00
I	8	Prepare Culture Media	29.70	0.73	0.22	88.22
A	11	Develop or Revise the Organization of the Section	26.40	0.81	0.21	88.43
B	4	Direct Subordinates in the Observance of Safety Practices	27.66	0.77	0.21	88.64
J	9	Perform Hematology Procedures for BleedingTime, Ivy Method	29.44	0.71	0.21	88.85
D	18	Show How to Locate and Interpret Technical Information	25.89	0.78	0.20	89.06
A	18	Plan and Schedule Work Assignments	24.11	0.83	0.20	89.26
M	29	Perform Biochemical Procedures for Salicylate Level	32.49	0.61	0.20	89.46
C	16	Recommend Special Corrective Action for Recurring Problems	26.65	0.72	0.19	89.65
C	8	Evaluate the Maintenance and Use of Equipment, Supplies and Work Space	23.86	0.80	0.19	89.84
N	18	Perform Urinalyses for Urinary Chlorides	35.03	0.54	0.19	90.03

Appendix (Continued)

SAMPLE DIFFERENCE DESCRIPTION

GROUP 1 = APPRENTICE DENTAL LABORATORY TECHNICIANS (N=30)
GROUP 2 = JOURNEYMAN DENTAL LABORATORY TECHNICIANS (N=272)

D	TSK	TASK TITLE	PERCENT PERFORMING, GROUP 2	PERCENT PERFORMING, GROUP 1	DIFFERENCE IN PERCENT PERFORMING GROUP 1 MINUS GROUP 2
K	14	Perform Dental Assistant Functions	12.87	33.33	20.47
G	3	Mix and Prepare Slurry Water	51.10	70.00	18.90
H	14	Flask Complete Dentures	54.78	73.33	18.55
M	6	Maintain Boilout Tanks	52.57	70.00	17.43
G	10	Mix or Prepare Duplicating Materials	20.96	36.67	15.71
I	3	Prepare Matrix for Denture Repair	54.41	70.00	15.59
M	7	Maintain Dehydrating Equipment Ovens	11.40	26.67	15.27
H	20	Pack Acrylic Dentures	54.78	70.00	15.22
H	10	Cure and Deflask Complete Dentures	55.51	70.00	14.49
H	26	Trim Casts	55.51	70.00	14.49
J	26	Trim and Wax-Dip Refractory Casts of Removable Partial Dentures	13.24	26.67	13.43
H	3	Articulate Cases	63.60	76.67	13.06
H	11	Eliminate Wax from Denture Molds	56.99	70.00	13.01
H	4	Bead, Box, and Pour Final Impression to Produce Stone Master Cast	47.06	60.00	12.94
H	9	Construct Trial Baseplates and Bite Rims	49.26	60.00	10.74
J	21	Soak Master Casts	29.78	40.00	10.22
M	13	Maintain Hanau Articulator and Articulator Mounting Plates	53.31	63.33	10.02
TASKS OMITTED WHERE DIFFERENCES IN PERCENT PERFORMING = 10.00 THROUGH -20.00					
K	17	Solder Units of Fixed Partial Dentures	33.46	13.33	-20.12
B	4	Supervise Dental Laboratory Specialists (AFSC 98250)	20.22	0.00	-20.22
M	16	Maintain Manual Casting Machines	33.82	13.33	-20.49
K	9	Fabricate Stone Dies	40.81	20.00	-20.81
I	9	Replace Tube Teeth or Facings	41.18	20.00	-21.18
K	15	Pickle or Heat Treat Gold Inlays, Crowns, or Pontics	37.87	16.67	-21.20
K	1	Cast Gold Crown, Inlay, or Pontic Backing	38.24	16.67	-21.57
K	19	Test Occlusion and Fit of Inlays, Crowns, or Fixed Partial Dentures	38.60	16.67	-21.94
I	8	Repair Metal Parts of Removable Partial Dentures	25.37	3.33	-22.03
B	13	Supervise the Fabrication of Dental Prosthetic Appliances	22.06	0.00	-22.06
K	10	Finish and Polish Gold Alloy Inlays, Crowns, or Fixed Partial Dentures	38.97	16.67	-22.30
K	18	Sprue, Invest, and Burn Out Gold Alloy Inlays, Crowns, or Pontics	38.97	16.67	-22.30
K	13	Grind in Porcelain or Acrylic Facings and Pontics	39.71	16.67	-23.04
K	2	Construct and Articulate Casts	43.38	20.00	-23.38
K	5	Fabricate Acrylic Resin Jacket Crowns	32.72	6.67	-26.05

Appendix (Continued)

EXAMPLE INDIVIDUAL JOB DESCRIPTION

CASE CTRL NUMBER = 1134
NAME = WITHHELD
GRADE = E-3 (A1C)
TOT MOS AFMS = 015
NO' SUBORDINATES = NONE
MAJOR COMMAND = AIR FORCE SYSTEMS COMMAND
PRES WORK ASGNMT = CIVILIAN PAYROLL CLERK
EDUCATION LEVEL = 14
PLAN TO RE-ENLIST = PROBABLY YES
I FIND MY JOB = FAIRLY INTERESTING
UTIL OF TAL/TRNG = FAIRLY WELL
JOB INSIDE US = YES
SUM TIME - CIV PAY = 99.9910,
ORGANIZATION/BASE = AEROSPACE MEDICAL DIVISION AFSC BROOKS AFB TEXAS

D-TSK	TASK TITLE	Per Cent Time Spent	Cumulative Per Cent
K 24	Prepare Individual Pay Records for Civilian Employees	8.00	8.00
K 30	Process Payroll Changes for Civilian Employees	6.67	14.67
K 17	Make Payroll Adjustments for Civilian Pay	6.67	21.33
K 15	Maintain Payroll Control Register for Civilian Employees	5.33	26.66
K 25	Prepare Payroll Change Slips for Civilian Employees	5.33	32.00
K 31	Process Time and Attendance Report	5.33	37.33
K 7	Compute or Post Allowances, Deductions, or Differentials for Civilian Pay	5.33	42.66
K 38	Verify Accuracy of Payments to Civilians	5.33	48.00
K 21	Prepare Computer Input for Civilian Pay Actions	5.33	53.33
K 28	Process and Post Basic Documents Authorizing Pay and Changes of Pay for Civilian Employees.	5.33	58.66
K 19	Post Service History and Physical Data to Individual Retirement Records	4.00	62.66
K 6	Compute or Post Allotments for Civilian Pay	4.00	66.66
K 12	Maintain Civilian Individual Leave Records	4.00	70.66
K 13	Maintain Files of Civilian Pay Documents	4.00	74.66
K 29	Process Civilian Cash Awards	4.00	78.66
K 11	Issue Civilian Pay Earning Statements	2.67	81.33
K 1	Audit Individual Leave Records	2.67	83.99
K 8	Compute or Post Special Pay for Civilians Such as Firefighter Pay	2.67	86.66
K 10	Initiate Card Change to Civilian Pay Accounts	2.67	89.33
K 32	Open or Close Civilian Pay Records	2.67	91.99
K 22	Prepare Employee's Federal or State Tax Report	1.33	93.33
K 2	Balance With Carriers on Each Type of Insurance Option	1.33	94.66
K 14	Maintain Insurance Application File	1.33	95.99
K 20	Prepare Bond Issuance Schedules for Civilian Employees	1.33	97.32
K 36	Re-establish Civilian Pay and Leave Records	1.33	98.66
K 23	Prepare Employer's Federal or State Tax Report	1.33	99.99

FUNCTIONAL JOB ANALYSIS

Sidney A. Fine

The presentation of Functional Job Analysis to this distinguished group on the occasion of this Navy Symposium looking forward to occupational research in 1980, happens to coincide with the 25th anniversary of this methodology. All persons registered for employment at the United States Employment Service are classified and coded according to the functional job analysis method. Its debut occurred in a paper I presented at the American Psychological Association in Chicago in 1948. The concepts in that paper were the outcome of my experience in developing job families in the Employment Service to assist in the mobility and placement of civilains during World War II and the development of a military occupational classification along functional lines. Essentially, in both instances, the object was to classify jobs according to their similarities in functional requirements of workers. The advantages for both worker and employer from the standpoint of flexibility, mobility, and maximization of training were clear.

The challenge was how to articulate these functional skills and how to relate them to functional requirements of jobs. This was the theme of the original paper and therein the research outlines for FJA were promulgated, later to become the Functional Occupational Classification Project of the United States Employment Service, a joint United States Air Force and Department of Labor undertaking.

Initially FJA was developed as a method of job classification in the employment service for use in placement, counseling and reporting. This was embodied in the 1965 third edition of the Dictionary of Occupational Titles. The main outlines of the classification system were completed in 1959. The FJA concepts were applied and researched in describing and paying hard science personnel at the Applied Physics Laboratory; in designing a rehabilitation workshop for schizophrenic patients in St. Elizabeths hospital; in measuring the impact of automation on job structure and worker health in several major manufacturing concerns; in designing a classification system for statistical reporting and placement of workers in developing countries under the aegis of the International Labour Office, and recently, in developing a system of training manpower specialists to develop and design jobs for disadvantaged persons.

In this last instance, FJA became a component of a Systems Approach to Manpower Planning and Utilization. It is this format that was incorporated in the National Task Bank of over 550 tasks in the social welfare industry and that is currently being used in one degree or another in manpower planning in the welfare departments of perhaps 25 states and numerous other public and private agencies. Two of the current applications are in an electrical manufacturing concern, where it is an input to management counseling; and in a bank, where it is the basis for developing an intergrated personnel system.

The theme of this presentation, suggested by my wife, follows this Zen saying:

> "If you are going to walk, walk
> If you are going to sit, sit
> But above all, don't wobble."

We laborers in occupational classification are all trying to get rid of the wobble in job analysis because reliable and valid information about jobs is so basic to everything that needs to be done in manpower and personnel work. Doctors McCormick and Crystal try to get rid of the wobble of rather uncertain inputs by using statistics and computers. I try to get rid of it through the use of words to control perceptions at the source. I prefer words because when push comes to shove, job analysis is a means of communication and communication is with words. I don't have to translate words into figures and figures back into words. Furthermore, values and needs are implicit in words and our organization of them into messages. It is in these messages about work to workers, supervisors, and decision makers where we need to find the ultimate explanation of our statistics anyway. In any case, let me hasten to say that in my opinion all of us are still working around the periphery of the central problem, if the central problem is productivity and worker satisfaction and growth. In the main, we are all focusing on the work itself as though the worker, like some depersonalized thing, comes to the work place geared to take his place and perform only those actions represented in a job description. This, of course, is not so. But nevertheless, there is something to be said for achieving clarity about the work itself and for this none of us need to apologize.

My presentation illustrated by the graphics on pages 71 to 75 follows this outline:

1. I will show you a Task Statement prepared according to FJA Technique and describe its structure.
2. I will describe how a Task Statement is controlled and how reliability and validity are achieved.
3. I will present two of the operational FJA Task Statements: Performance Standards and Training Content.
4. I will briefly discuss the task in the work situation.
5. I will consider the place of the task in the System and some applications therein.

As a result, I hope you will see the attempt to eliminate the wobble, the importance of task rather than job, and finally that FJA in its present formulation is far more than a job analysis technique. It is nothing less than a total system of perceiving and thinking about people at work, even though some parts are as yet terra incognita.

The Task Statement

Functional Job Analysis defines a task as follows:

"A task is an action or action sequence grouped through time, designed to contribute a specified end result to the

> accomplishment of an objective and for which functional levels and orientation can be reliably assigned. The task action or action sequence may be primarily physical (such as operating an electric typewriter), or primarily mental (such as analyzing data) and/or primarily interpersonal (such as consulting with another person).*"

From the first graphic, the important elements of a task statement can be seen. there are two such elements: (1) the action the worker is expected to perform; and (2) the result expected of the worker action. The action is: Types/transcribes standard form letter; and the result expected is: To prepare letter for mailing. You will note that these two elements are separated by the prepositional phrase, "in order to." Additional material is included in the task statement which indicates the resources the worker draws upon for the task, and some indication of the level of instruction, that is, the prescription/discretion mix, that the worker must follow.

This format for the task statement fulfills the definition of the task and answers the five basic questions that FJA asks as to the information the task statement is supposed to provide, namely:

Who:
What Action?
To accomplish what immediate result?
With what tools/equipment/work aids?
Upon what instructions?

In the task statement shown, the additional information is represented by the phrases: "Including specified information from records provided, following standard operating procedure (SOP) for form letter, but adjusting standard form as required, for clarity and smoothness."

Controls

Task statements are spoken of as controlled. This means that the functional levels and orientation can be reliably assigned as required by the definition. Levels and orientation are the two measures based on the worker function scales shown in this second graphic. The Worker Functions scales relate to data, people, and things. These scales, which are used in the DOT Classification System to classify all jobs in the American economy, purport to describe all the possible things that people can do to get work done. The scales are ordinal; that is to say, any function in the scale includes the functions below, and exclude the functions above. The method for using these scales is to assign one function from each scale - the highest applicable in each instance - to any given task. This is done on the theory that a whole person is functioning in every signle instance, and he is functioning physically, mentally, and interpersonally in relation to some type of data, people, and things input, although the mix of these three may vary considerably. Thus, in the task shown in the first graphic, the three relevant functional levels are: compiling (for data); taking instructions (for people); and operating/controlling (for things). By selecting these three functions for this task, the worker's relationship to all possible functions, all possible actions workers can do are indicated. This is the level measure. The orientation measure seeks to show the relative involvement of the worker with data, people and things, the total being 100%. The convention used is to indicate this in units of 5% and assigning at least 5% where hardly any involvement is indicated. This is done on the theory that the whole person is involved even if you can't see it. The orientation percentages are 70% for data, 5% for people, and 25% for things. The primary involvement in this task is considered to be data, the secondary involvement things, with the people involvement being negligible. The 70% assigned to data signifies that even though this task involves workers with a typewriter, on a continuous basis, the standards on the basis of which this worker will primarily be judged in this task are data standards.

There are four more scales, all of which appear in the brochure Functional Job Analysis Scales: A Desk Aid. From the other information in the task, using these other four scales, it can be determined that this worker is functioning on an instructional level of 2, a reasoning level of 3, a math level of 1, and a language level of 4. Now the important thing about the ratings is that they can be reliably arrived at, which is part of the definition for a task. What this means is, that any group of people looking at this task individually would assign approximately the same ratings for this task. This is what is meant by a controlled task statement.

Operational Inferences FJA Task Statements

The original task statement shown in the first graphic/and the superimposed message on it must be noted.

"To do this task, to these standards, the worker needs this training."

From an explicit task statement it is possible to derive two types of performance standards - (1) descriptive standards; and (2) numerical standards. Although stated somewhat generally, these standards derive directly from the task statement itself. There is no great leap into recondite or abstract concepts. In methodology, one uses both types of performance standards, because he recognizes the potential of descriptive standards to cover the wholeness of a performance, and the numerical standards to cover very limited, measurable aspects of a performance.

When a task is explicitly stated in this form, when it is controlled for reliability, and from which performance standards of the type indicated can be formulated - then it is possible to express the training required. Here again are noted two types of training - (1) the more generalized or functional training; and (2) the specific content training relating to the particular work situation in which the task occurs. Another way to think of these two types of training is that the functional training is the general training which the person brings to the job, whereas the specific training relates to the skills he acquires in the particular establishment in which he is working, on-the-job-training. These statements refer directly to the standards and to the task, and together the three areas of information form a whole, summarized by the concept that to do this task to these standards the worker needs this training. When one examines these three types of information it is noted that the task statement focuses on verbs, the performance standards on adjectives and adverbs, and the training content on nouns.

The Task in the Work Situation

In this graphic and the one that follows, note the task, the unit of observation, in the larger context of the work situation. In FJA the behavior or worker action phrase is ultimately expressed in terms of Things, Data, and People functions. It is a resultant of worker qualifications. The worker can perform the task at the specified level of functioning and the standards required because of his aptitudes, his basic generic skills in reading, in math and language, and on top of that his training and experience. When one looks at the aptitude profile requirements developed with tests like the General Aptitude Test Battery (GATB) he will find that a dominant function or combination of functions consistently calls for similar patterns of minimum aptitudes. FJA is as good a method as any available today to establish synthetic validity. Because it focuses on tasks and requires a thorough task analysis of a job, it may actually prove to have an advantage in precision over other methods.

On the other side of the task, the end result, the precise objective of the behavior, needs to be a contribution to the objective of the organizational activity and is indeed determined by the purpose, goals, resources, and constraints of the work-doing system.

The second graphic illustrating the task in the work situation is intended to show the level of specificity for which FJA strives. It shows levels of specificity in task statements beyond the functional levels attempted by FJA. It is possible to express actions as physical motions as in time and motion study, a minuteness that is quite desirable for engineering and physical rehabilitation purposes but quite ineffective for communicating ordinarily perceived work activities. Such detail would parallel the output specifications used to describe the potential of machines and equipment.

Although FJA rejects this level of specificity, this chart and the analogous formulations that it demonstrates can be made in engineering contexts. It approaches the matter of perceiving and describing work activity with an attempt at engineering precision.

The Task in the System

The more we analyzed the task from the functional standpoint, the more we began to understand the work situation. We proceeded to explore the work situations from the standpoint of productivity and of worker growth. As we enlarged our vision and our experience we even dared to think that we had somehow captured a fundamental unit of observation and that perhaps we had the tiger by the tail. This is represented in the next graphic, which portrays the work-doing system.

As you can see, we conceived the work-doing system as focused on the dual purpose of Productivity and Worker Growth. We then asked: What are the components that contribute to this dual purpose? The answer, hardly a revelation, appeared to be: The Worker, the Work Organization, and the Work. Did this simple formulation actually encompass all the significant variables of a work-doing system? Suffice it to say in this limited space and time that, as I have elsewhere elaborated, the answer to that question is proving to be

"YES". At any rate, it has been a formulation of enormous power on the basis of which it has been possible to develop a Systems Approach to Manpower Planning. As you saw a little while ago, this graphic is really a systems version of the graphic showing the inputs to the tasks. It is a sort of oak tree that grew out of the acorn, or perhaps a beanstalk that emerged from the bean. Who knows how high it will grow or where it shall lead.

Already, it has led very constructively to interesting places. By careful analysis of the structure of each component and the dynamics of their interaction, we have been able to develop specific meta-tools for each component. For example, with regard to the worker, we have developed a semi-structured interview that can be administered as a self-report or as a face-to-face interview. In both instances, we have added significant skills to the armamentarium of the personnel interviewer.

With regard to the Work, we have developed a definitive technique for job design and work flow analysis as well as the analysis of tasks which is basic. Here we have provided fundamental skills of a professional nature to the occupational analyst.

With regard to the Work Organization, we have developed a system analysis approach that ties organizational analysis to work and worker analysis, and an organization's goals and objectives to a worker's tasks. In doing so, a channel of communication is provided between management and the worker.

I have described FJA as an analytic tool and as an heuristic device. I should like to conclude by stressing its use as a language of communication among the personnel most concerned with the basic components of the manpower system.

In recent years, man has discovered that the achievement of ordered efficiency and its introduction into life processes is not the answer to his problems it once seemed. On the contrary, unique and disparate technologies, although clever and effective in themselves and in terms of the specific problems to which they have been addressed, tend to find themselves in competition and often in conflict with one another resulting in something less than efficiency--in fact, resulting in partializing, separating, fragmenting--the whole is lost in sophisticated disharmony of the parts. What has inspired and encouraged me about my 25 years of work with FJA is that FJA has had the reverse effect. It has brought things together. It has brought people together. It has created an ever deeper understanding of, and an ever greater organic wholeness in an approach to work. I commend it to you.

FOOTNOTES

*S. A. Fine and W. W. Wiley, "An Introduction to Functional Job Analysis," W. E. Upjohn Institute for Employment Research, 1971.

References

Sidney A. Fine and Wretha W. Wiley, An Introduction to Functional Job Analysis.

Sidney A. Fine, Functional Job Analysis Scales: A Desk Aid.

Sidney A. Fine and Freda Bernotavicz, Task Analyst: a multi-media training course; W. E. Upjohn Institute for Employment Research.

GRAPHIC 1

Data	People	Things	Data	People	Things		Reas.	Math.	Lang.	
W.F. -- LEVEL			W.F. -- ORIENTATION			INSTR.	G. E. D.			TASK NO.
3B	1A	2B	70%	5%	25%	2	3	1	4	

GOAL: (To be completed by individual user.)

OBJECTIVE: (To be completed by individual user.)

TASK: Types/transcribes standard form letter, including specified information from records provided, following S.O.P. for form letter, but adjusting standard form as required for clarity and smoothness, etc., in order to prepare letter for mailing.

TO DO THIS TASK

PERFORMANCE STANDARDS

Descriptive:

- Types with reasonable speed and accuracy.
- Format of letter is correct.
- Any changes/adjustments are made correctly.

Numerical:

- Completes letter in X period of time.
- No uncorrected typing, mechanical, or adjustment errors per letter.
- Fewer than X omissions of information per X no. letters typed.

TO THESE STANDARDS

TRAINING CONTENT

Functional:

- How to type: letters.
- How to transcribe material, correcting mechanical errors.
- How to combine two written sets of data into one.

Specific:

- How to obtain records and find information in them.
- Knowledge of S.O.P. for standard letter format: how/where to include information.
- Knowledge of information required in letter.
- How to use particular typewriter provided.

THE WORKER NEEDS THIS TRAINING

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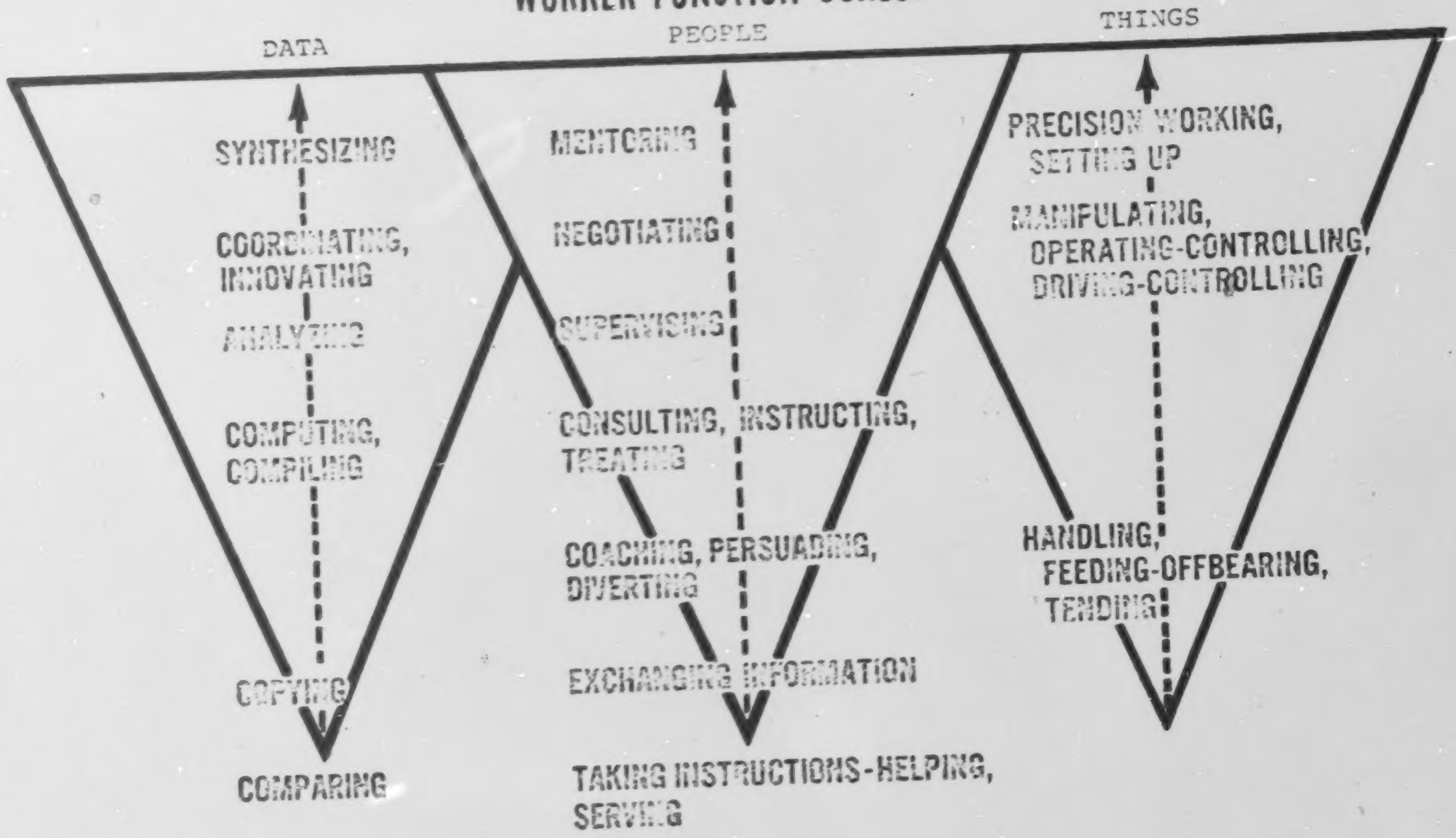
GRAPHIC 2

WORKER FUNCTION SCALES


DATA
SYNTHESIZING
COORDINATING, INNOVATING
ANALYZING
COMPUTING, COMPILING
COPYING
COMPARING
PEOPLE
MENTORING
NEGOTIATING
SUPERVISING
CONSULTING, INSTRUCTING, TREATING
COACHING, PERSUADING, DIVERTING
EXCHANGING INFORMATION
TAKING INSTRUCTIONS-HELPING, SERVING
THINGS
PRECISION WORKING, SETTING UP
MANIPULATING, OPERATING-CONTROLLING, DRIVING-CONTROLLING
HANDLING, FEEDING-OFFBEARING, TENDING

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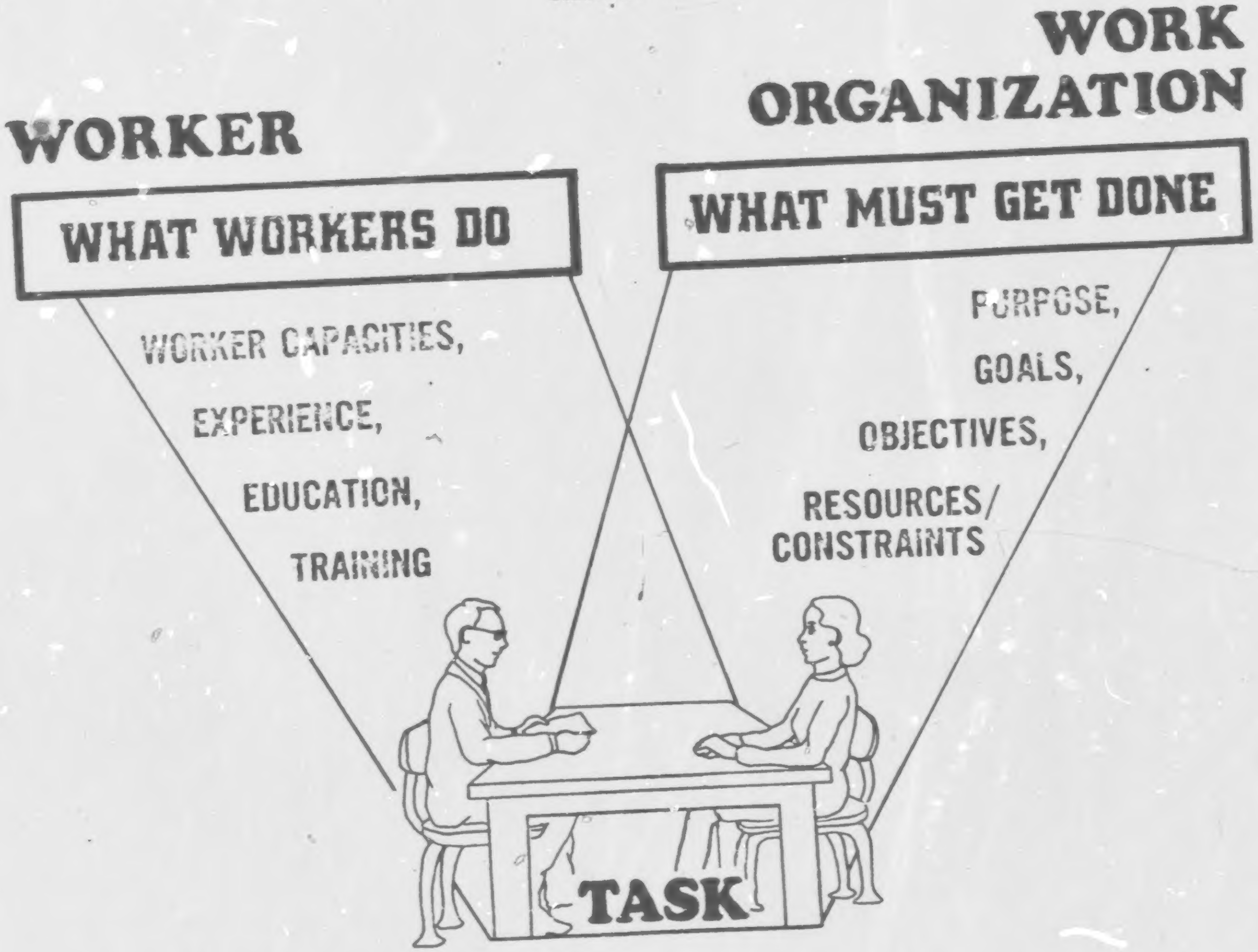
GRAPHIC 3


WORK ORGANIZATION
WORKER
WHAT WORKERS DO
WHAT MUST GET DONE
WORKER CAPACITIES,
EXPERIENCE,
EDUCATION,
TRAINING
PURPOSE,
GOALS,
OBJECTIVES,
RESOURCES/
CONSTRAINTS
TASK

TASK ANALYSIS: THE WHOLE PICTURE

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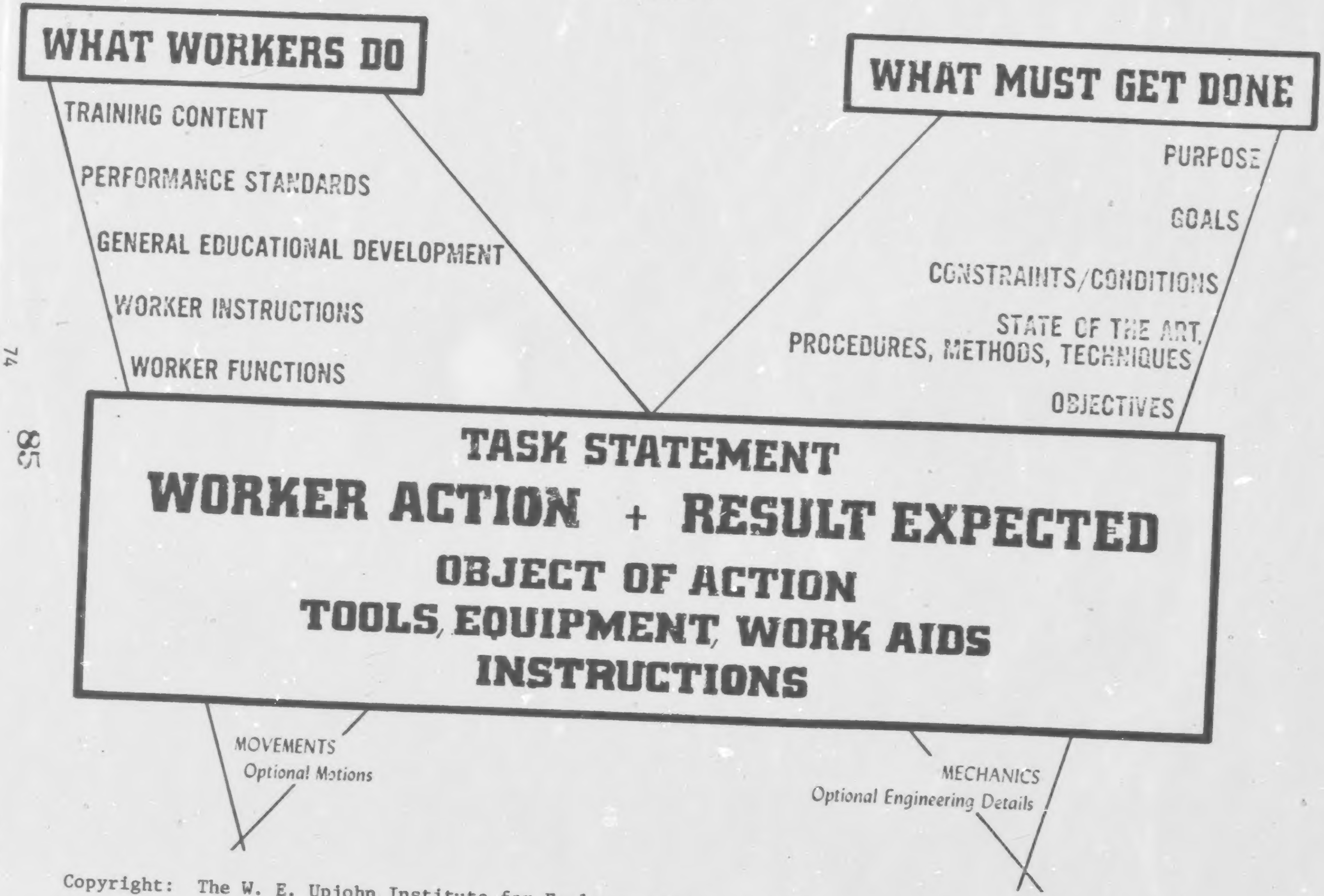
GRAPHIC 4



WHAT WORKERS DO

TRAINING CONTENT
PERFORMANCE STANDARDS
GENERAL EDUCATIONAL DEVELOPMENT
WORKER INSTRUCTIONS
WORKER FUNCTIONS

WHAT MUST GET DONE

PURPOSE
GOALS
CONSTRAINTS/CONDITIONS
STATE OF THE ART,
PROCEDURES, METHODS, TECHNIQUES
OBJECTIVES

TASK STATEMENT
WORKER ACTION + RESULT EXPECTED
OBJECT OF ACTION
TOOLS, EQUIPMENT, WORK AIDS
INSTRUCTIONS

MOVEMENTS
Optional Motions

MECHANICS
Optional Engineering Details

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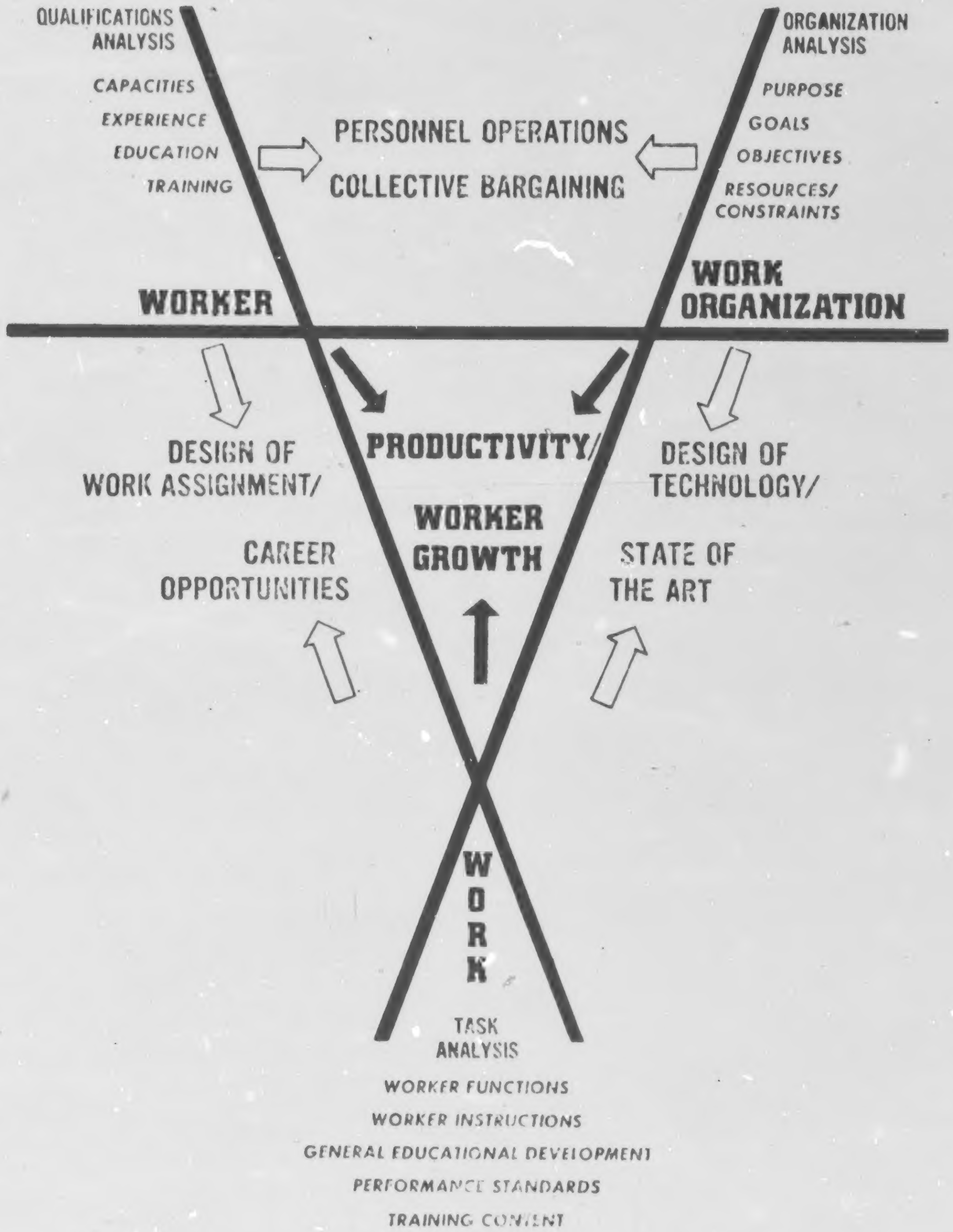
GRAPHIC 5

A SYSTEMS APPROACH TO MANPOWER PLANNING


QUALIFICATIONS ANALYSIS
CAPACITIES
EXPERIENCE
EDUCATION
TRAINING
PERSONNEL OPERATIONS
COLLECTIVE BARGAINING
ORGANIZATION ANALYSIS
PURPOSE
GOALS
OBJECTIVES
RESOURCES/ CONSTRAINTS
WORKER
WORK ORGANIZATION
DESIGN OF WORK ASSIGNMENT/
CAREER OPPORTUNITIES
PRODUCTIVITY/
WORKER GROWTH
DESIGN OF TECHNOLOGY/
STATE OF THE ART
WORK
TASK ANALYSIS
WORKER FUNCTIONS
WORKER INSTRUCTIONS
GENERAL EDUCATIONAL DEVELOPMENT
PERFORMANCE STANDARDS
TRAINING CONTENT

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THE CONCEPT OF MODULES IN MILITARY JOBS[1]

Robert W. Stephenson

and

Bertha H. Cory - Cecil D. Johnson

A new, more specific language to describe jobs is being developed based upon clusters of work tasks that tend to go together occupationally and organizationally in meaningful ways. The task clusters have been tentatively titled "duty modules". Current research is focused upon testing the construct validity of duty modules based upon job content for potential application to personnel management, occupational training, and manning table preparation systems of the Army.

Originally, job content modules were formulated for the predominant enlisted MOS in the Infantry Rifle Platoon, using job analysis data from the Army's Military Occupational Data Bank. Since no similar basic source data were available for a required set of Officer MOS, specially designed job analyses were conducted on jobs that Infantry and Quartermaster Officers fill. These task data were used to formulate an experimental set of officer job content modules which served as a companion to the enlisted job content modules. Both sets were constructed on the basis of occupational similarity.

The experimental job content modules were then put to various tests to determine their coincidence with the clustering of tasks that occur in actual assignments in field units, and with the mission elements which are activities that are used to design and evaluate the performance of organizational units.

Testing that has been done to date indicates that the duty modules that were designed appear to have some useful and valuable characteristics.

* They are designed in terms of a variety of job specialties rather than a single one, and show a more definitive cross relationship between jobs and MOS.

* They are designed in terms of economy in that they describe a position with fewer items than a task description, but are more specific than a generalized MOS.

* They are readily adaptable to computer processing, and can currently use the CODAP system of task analysis.

* They can be related to unit capability and performance at a level of activity common to both job classification, personnel assignment, and career management.

Analysis in process will provide a basis for modifying and improving the utility of the duty modules. However, the very modularity of the task clusters requires that a wide number of MOS, units, and manning-table duty positions be used in validating the modules. Evidence from all MOS and duty positions with which a duty module is concerned is needed before a final resolution on a specific duty module can be obtained.

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[1] This is an abstract of Dr. Stephenson's presentation. A complete report on the duty module concept will be published later by the U.S. Army Research Institute for the Behavioral and Social Sciences based on work being carried on under their contract, DAHC19-71-C-0004 "A Taxonomic Base for Future Management Information and Decision Systems", with the American Institutes for Research, Washington, D.C.

POSITION ANALYSIS QUESTIONNAIRE (PAQ)[1]

Ernest J. McCormick

Previously the field of occupational analysis has generally been characterized by verbal descriptions of job activities and other job variables. The conventional essay type job descriptions certainly provide useful information for other purposes; however, it would be useful to have job data that have been more systematically collected making possible some form of "quantification" of relevant job information. Recently there have been a few approaches to the analysis of jobs somewhat more systematic and providing for such quantification.

In this regard, we have developed what we refer to as the Position Analysis Questionnaire (PAQ), the intent of which was to fulfill the following objectives:

1. To provide a generalized, structured, job analysis procedure lending itself to use in the analysis of a wide range of jobs. Fulfillment of this objective would require analysis of jobs in terms of each of a number of "units" of job-related data and particularly, the use of units that would characterize corresponding human behaviors that might be involved in jobs in various technological areas. We have referred to such units as "worker-oriented" job elements, as contrasted with "job-oriented" job elements. The worker-oriented job elements tend to characterize or imply the human behaviors in jobs rather than the work outputs of jobs.

2. To incorporate in a basic frame of reference the analysis procedure that is predicated on the basic "types" of functions characterized by the psychologists as the stimulus-organism-response paradigm (S-O-R). (An organism receives stimuli from the environment, such stimuli operating on the organism to bring about a response.) Operationally, it was planned that provision be made in the job analysis procedure for analyzing jobs in terms of information input, mediation processes, and output. In addition, provision was made for analyzing jobs in terms of interpersonal relationships, situational variables, and miscellaneous characteristics.

3. To provide for the quantification of job-related data by the application of appropriate measurement techniques and principles in the analysis process.

Nature of the PAQ

The PAQ used in the research to be reported (Form A) included 189 job elements, each of which provided for the analysis of any given job in terms of "human behaviors," or that would imply such behaviors. The PAQ was organized into six divisions that incorporated the frame of reference mentioned above (information input, mediation processes, and output). These divisions are listed below, along with an example of a job element in each division.

Division of PAQ	Example of Job Element
1. Information Input	Use of Written Materials
2. Mediation Processes	Coding/decoding
3. Work Output	Use of Keyboard Devices
4. Interpersonal Activities	Interviewing
5. Work Situation and Job Context	Working in High Temperatures
6. Miscellaneous Aspects	Irregular Hours

In the analysis of jobs using PAQ, provision was made for the use, with any given job element, of an appropriate rating scale. Various types of scales were used, such as the following:

Importance. (The importance of the job element to the job.)

Time. (The time for which the behavior or situation is applicable).

Use. (The "use" of certain materials, such as sources of job information.)

Special codes. (These were used in the case of certain specific job elements.)

Check items. (For certain job elements there was provision for indicating whether the element did or did not apply to the job.)

Except for the check-list scales, most of the scales were six point scales.

Job Dimensions Based on the PAQ

Job data based on the PAQ were subjected to a series of factor analyses in order to identify what are referred to as "job dimensions." In these analyses, data for 536 jobs were used, including those from many different industries, and representing a wide variety of jobs. One factor analysis was carried out on the basis of 150 of the job elements. (The job elements not included in this analysis were those used infrequently in the analysis of jobs, or used with limited reliability.) This factor analysis, referred to as an "overall" factor analysis, resulted in the identification of the 5 "overall" job dimensions. The other factor analyses were carried out with the job elements within each of the six divisions of the PAQ, as listed above. These factor analyses resulted in the identification of 27 job dimensions. Examples of the job dimensions resulting from these factor analyses are:

Division of PAQ	Example of Job Dimension
1. Information Input	Visual Input from Devices/Materials
2. Mediation Processes	Information Processing
3. Work Output	Machine/process Control

Division of PAQ	Example of Job Dimension
4. Interpersonal Activities	Job-related Information Exchange
5. Work Situation and Job Context	Personally Demanding Situations
6. Miscellaneous Aspects	Unstructured vs. Structured Work

Given such job dimensions, it is possible to derive, statistically, a job dimension score (actually a factor score) for each job on each of the dimensions. These factor scores are based on an equation consisting of statistically-derived weights for the ratings on those particular job elements which dominantly "characterize" the job dimension in question. Thus, for any given job it is possible to derive a profile of job dimension scores. These job dimension scores were used as quantitative indexes of jobs in connection with two experimental applications of PAQ data. One of these applications was in the framework of estimating the aptitude requirements of jobs, and the other in the framework of estimating compensation rates for jobs.

Use of PAQ Data for Job Component Validity

One of the possible applications of PAQ data about jobs is in the context of job component validity (what has commonly been referred to as synthetic validity). In general terms, this concept is predicted upon the assumption that jobs involving the same basic "human behavior" require the same basic human attribute(s) - in so far as that particular human behavior is concerned. In the case of data from the PAQ, it is hypothesized that jobs comparable in terms of job dimension scores on a given job dimension presumably require essentially the same human attribute(s) for successful performance of such behavior. If the level of the human attribute required for performance of some basic type of human behavior can be determined with reasonable statistical confidence, it would then be possible to apply such findings to other jobs. Thus, the basic frame of reference of the job component validity concept is the attribute requirements of jobs might be derived statistically on the basis of "common denominators" of jobs without need for conventional test validation procedures in the case of each and every job.

In exploring the possible use of PAQ data for the purpose of establishing the job component validity of jobs the mean test scores on each of 9 tests of the General Aptitude Test Battery (GATB) of the United States Training and Employment Service for 90 jobs were used. These mean test scores were used as indications of the relative "importance" of the attributes measured by the individual tests to successful performance of the jobs, on the assumption that the individuals have tended to grativate into jobs that are commensurate with their own abilities. Thus, for any given test, it would be assumed that the jobs whose incumbents have high mean test scores on that test require more of the quality measured by the test than those jobs whose incumbents have low mean test scores.

PAQ's for 179 jobs corresponded with these 90 jobs for which GATB test scores were available. (In certain instances PAQ's were available for 2 or more jobs that corresponded with 1 of the 90 jobs.)

The job dimension scores of the 179 jobs were used as "predictors" of mean test scores of incumbents on the corresponding 90 jobs, separate analyses being carried out for each of the 9 tests for which test scores or incumbents were available. By use of a regression analysis, it was possible to identify statistically a combination of job dimension scores that gave the optimum degree of correlation with the mean test scores of job incumbents. The multiple correlations resulting from this analysis are listed below for the 9 tests.

GATB Test	Multiple Correlation
G - Intelligence	.78
V - Verbal	.80
N - Numerical	.75
S - Spatial	.70
P - Form perception	.62
Q - Clerical perception	.73
K - Motor coordination	.71
F - Finger dexterity	.64
M - Manual dexterity	.59

These correlations range from .59 to .80 with a median of .70. The magnitude of these correlations strongly suggests it would be possible to estimate the aptitude requirements of jobs on the basis of quantitative data from the PAQ, without need for conventional test validation.

Estimation of Compensation Rates for Jobs Based on the PAQ

In connection with establishment of compensation rates of jobs, one might hypothesize such rates should be comparable for jobs with similar requirements as far as human behaviors are concerned. The basic approach to application of PAQ data in this frame of reference was comparable to that used in the job component validity phase mentioned above. In this instance, however, the "criterion" used was the monthly wage or salary rate for each job included in the analysis. A sample of 340 jobs from a variety of industries and different parts of the country was used in this phase. The job dimension scores for these jobs were used as predictors of their monthly rates of compensation. A cross-validation procedure was used which involved dividing the total sample into two sub-samples, and deriving, by regression analysis, the combination of job dimension scores that best predicted the going rates within the sample. The resulting equation derived for one sample (subsample A or B) was then applied to the other sample (subsample B or A respectively). The estimated compensation rates so derived were then correlated with actual rates of pay in the sample in question.

Multiple Correlation Initial sample		Cross-Validation Correlation Other sample	
A	.87	B	.85
B	.90	A	.83
A & B	.87		

I-4.4

The correlations generally were in the mid- to upper-eighties. In a couple of specific situations estimated compensation rates (based on the results of analyses of these 340 jobs), as applied to jobs in each of two organizations, resulted in correlations with actual rates of pay for jobs in those organizations of .93 and .94.

Discussion

On the basis of data derived from the study, it seems evident the use of a structured type of job analysis procedure, such as the PAQ, can serve as the basis for quantifying jobs in a manner that may serve certain practical objectives. In turn, it appears to be within the realm of possibility to use data so generated as the basis for establishing aptitude requirements for jobs and deriving indexes of job values that can be used directly for getting compensation rates. To the extent these objectives could be fulfilled it would then be possible to eliminate the usual test validation and job evaluation procedures otherwise required.

Application of PAQ to Naval Billets

The PAQ was used in the analysis of a sample of naval billets as the basis for comparison of compensation rates for naval personnel related to the compensation rates that would be applicable to civilian jobs with corresponding job characteristics. The sample included 617 billets of enlisted personnel aboard three aircraft carriers and in 6 air squadrons, and the billets of 249 officers at that time attended the Naval Postgraduate School or attached to the Naval Safety Center. In the case of the officer billets, the officers themselves used the PAQ as the basis for describing the billet held on their previous assignment.

As the basis for the estimation of compensation rates for naval personnel, three sets of assumptions were made, varying in the assumed "status" of the individual, including his dependency status and his "intent" to remain in the service (which would, of course, influence the estimated financial benefits in the form of retirement pay). In general terms, these assumptions provided a "high" and "low" value for each hypothetical incumbent, and might thus reflect the "range" of financial benefits that could be characteristic of incumbents of any given rate or rank.

On the basis of the PAQ analyses of the billets, a compensation rate estimate for civilian jobs with corresponding characteristics was derived, based on data from a fairly large sample of civilian jobs that had been analyzed with the PAQ. These values were adjusted to reflect average increments in earnings since the original data were obtained for the civilian jobs.

The comparisons were made on two bases; namely, the estimate of the direct or "take home" pay (including certain specific money equivalents) and total compensation (including all possible forms of fringe benefits, as might be applicable to both naval and civilian jobs).

Results of these comparisons are shown in Figures 1 and 2. Note that comparisons in the case of certain ranks are based on very small numbers of cases; and thus should be discounted.

By and large, these comparisons point up the fact that the actual compensation for incumbents of naval billets tends to be lower than that for incumbents of civilian jobs having similar characteristics.

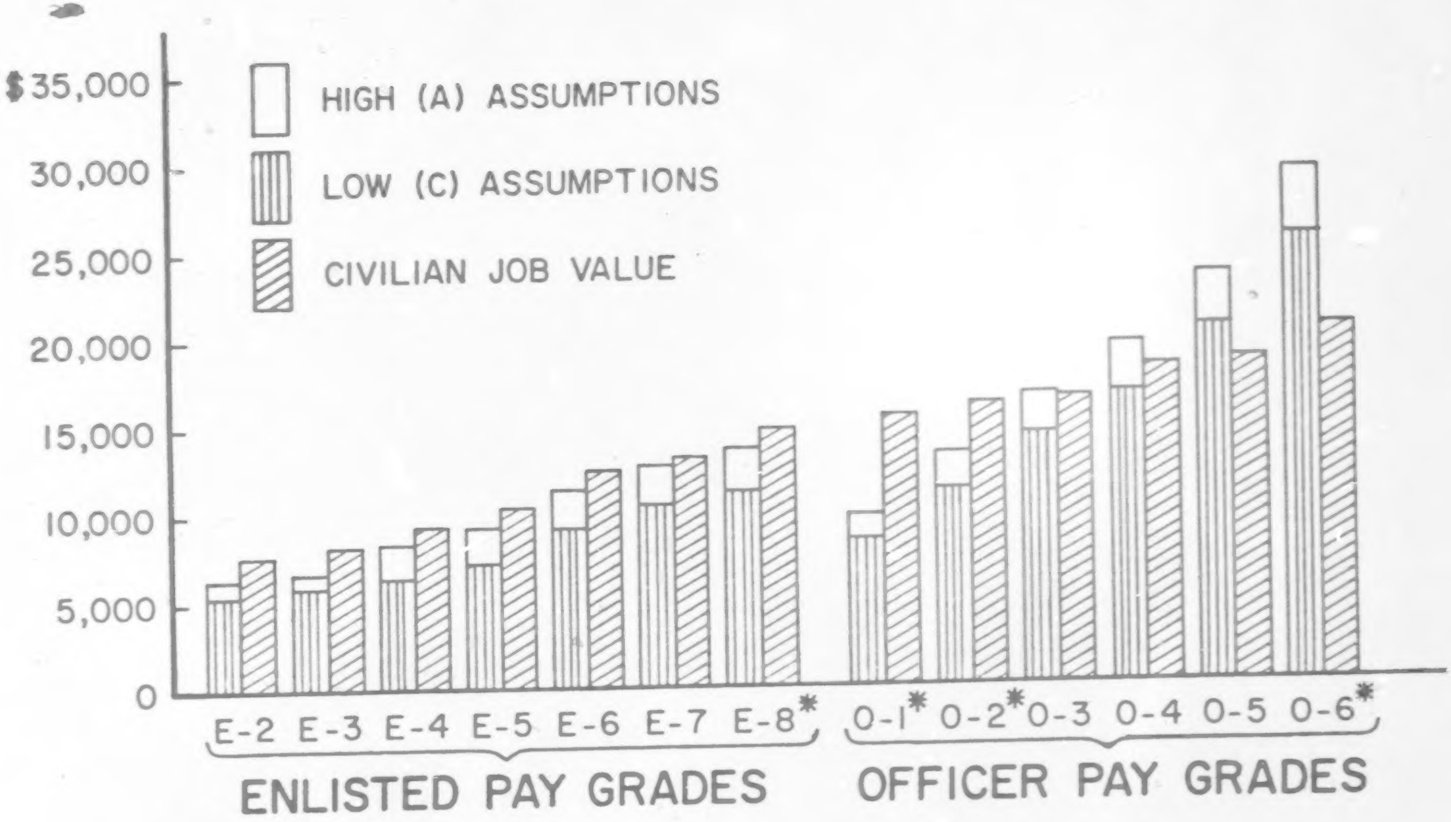

Figure 1

Mean Annual Direct Naval Compensation Rates Under High and Low (A and C) Pay Assumptions, and Mean Annual "Civilian Job Value" For Each Pay Grade

Note: Values in pay grades marked with an asterisk were based on between 4 and 12 job analyses.

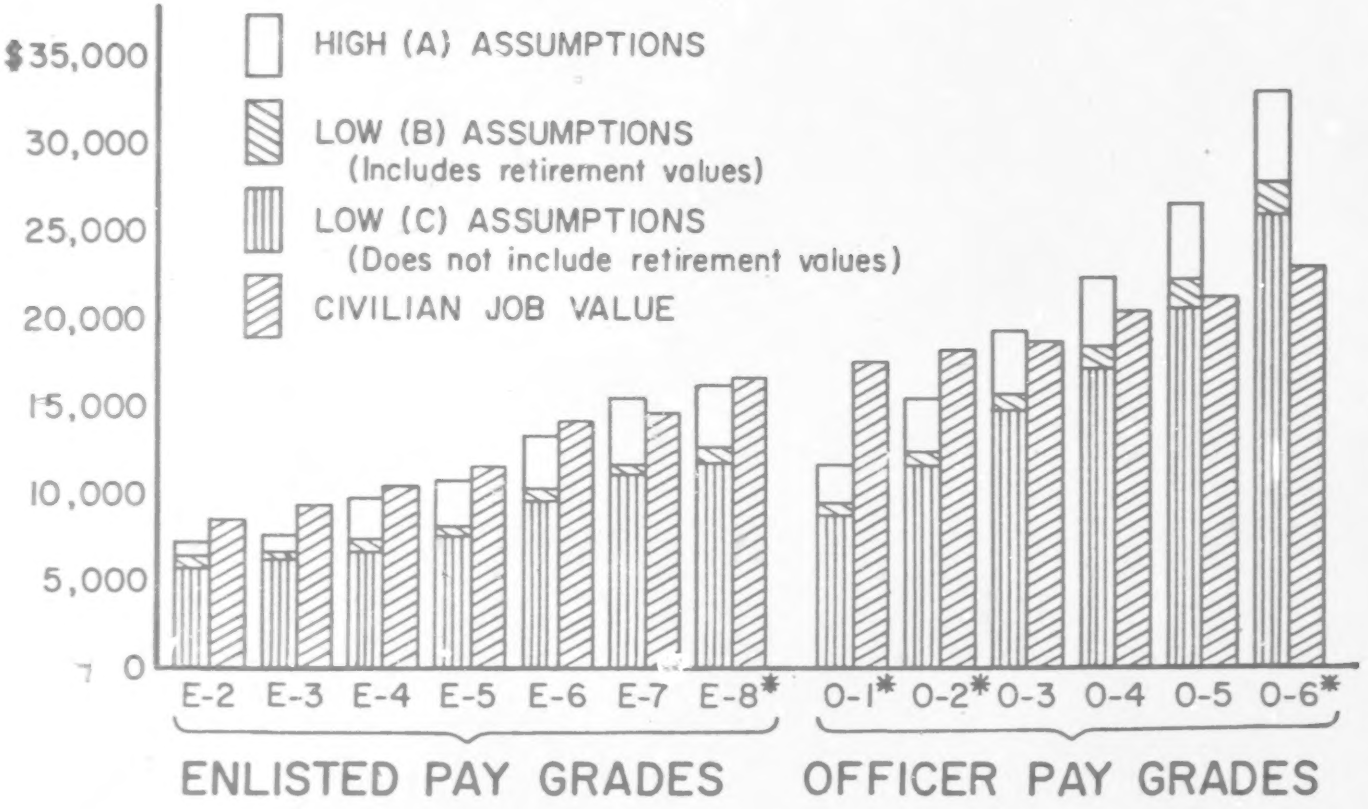

Figure 2

Mean Total Annual Naval Compensation Rates Under Varying (A, B and C) Pay Assumptions, and Mean Annual "Civilian Job Value" (Including Fringe Benefits) For Each Pay Grade

Note: Values in the pay grades marked with an asterisk were based on between 4 and 12 job analyses.

FOOTNOTES

[1] This paper is based in large part on the following:

McCormick, E.J., Jeanneret, P.R., & Mecham, R.C. A study of job characteristics and job dimensions as based on the Position Analysis Questionnaire (PAQ). Journal of Applied Psychology, 1972, 56 (4), 347-368.

SECTION II

CAREER DEVELOPMENT

Dr. Edwin A. Fleishman, Chairman

Career Development - Introductory Remarks	Dr. Edwin A. Fleishman
Holland's Theory and the Concept of Congruence	Dr. Walter B. Walsh
A System for Decision Making Development During Career Development	Dr. David D. Tiedeman Dr. Anna Miller Tiedeman
A Theoretical Model	Dr. Abraham K. Korman
Personal Value Systems of Managers and Administrators	Dr. George W. England
Career Motivation in the Navy	Dr. Albert Glickman

CAREER DEVELOPMENT SESSION

INTRODUCTORY REMARKS

Edwin A. Fleishman

The general area of research on careers is quite an active one at present, covering a variety of facets. The Navy's interest in this field, as a research domain, was until recently primarily directed at problems of personnel retention in the Navy. A great deal of effort was expended on identifying what factors lead to retention of Navy personnel after the first or subsequent enlistments, with a view to translating these findings into policies and procedures for getting personnel to re-enlist.

The new emphasis on problems facing the Navy as a result of the all volunteer defense forces and zero draft have forced us into a more sophisticated and differentiated look at the Navy's career motivation and development problems. Consequently, it is timely that we examine what is happening in research on various aspects of this problem in other sectors as well as in the Navy.

As I reviewed this general area of work, to prepare this session of the program, I thought about the areas that ought to be represented. There appeared to be a number of people with models, with various ones in different stages of development and with different amounts of data to support such models. These models had been applied in different contexts--educational, managerial, industrial, military and the like.

Some research has been mainly descriptive, emphasizing what happens as occupational choices are made at different points in career progression. Other research has been interested in the motivational aspects of careers. In this work, interest is in the needs and incentives which bring an individual into a career field. Why does he choose a given field or why does he stay in it? What are the motivational factors that energize and channel individual behavior in a given career progression?

The topic of socialization is another increasingly investigated one in this area. Once in a career field, or in an organizational setting, what are the factors in the individual's environment and life space which shape his choices? Another related focus in this area is centered on the process of decision-making. What is the decision-making process that individuals engage in at various stages of their life and work histories?

Then, there are the active areas of research on career counseling and occupational information systems. These may be institutional (such as systems in business, education, and military contexts) and individual (such as that involved in the individual counseling setting). And, finally, there is the increasing concern between individual and organizational needs and values and the interaction between them as a basis for understanding and predicting the career development process.

In selecting our participants I have tried to keep these aspects of the problem in mind. We are fortunate in having some of the leading researchers in the country now working in these areas. Our format is to begin with some general theoretical and conceptual developments and their application. We will then move to some specific methodological developments and specific problem applications, closing with recent work on specific Navy career motivation questions.

Specifically, Dr. Walsh will deal with Holland's theory of occupational choice and, in particular, with the concept of congruence which has proven useful in this area. Dr. Tiedeman will describe a system for decision-making at various critical points during an individual's career, with emphasis on computer applications in the counseling process where occupational information can be more effectively applied to the individual's needs. Dr. Korman will deal with the individual once he is in a career pattern and will focus on changes in career patterns and the conditions under which people continue to grow or decline in their career achievements. Dr. England will describe his work on the value systems of managers and adminisrators with emphasis on the measurement of values. His interest, in part, has been on ways careers influence values and how values influence careers.

Finally, Dr. Glickman will describe some recent model development and research on career motivation in the Navy context.

HOLLAND'S THEORY AND THE CONCEPT OF CONGRUENCE

W. Bruce Walsh

Holland, regarding interests and vocational preferences as expressions of personality, developed a theory of careers (Holland, 1973). In his theory Holland makes three assumptions based on the notion that vocational behavior is a function of the interaction between the person and the environment. The first assumption is that people may be characterized by their resemblance to one or more personality types (the Realistic type, the Investigative type, the Social type, the Conventional type, the Enterprising type, and the Artistic type). In general people possess characteristics of all 6 types, but Holland suggests that each individual behaves in a manner which reflects one or two of these orientations more strongly than others. Therefore, the closer an individual resembles a type, the more likely it is he will exhibit personal characteristics and behavior consistent with that type. To operationalize the six personality types Holland developed the Vocational Preference Inventory (Holland, 1965) and more recently the Self Directed Search (Holland, 1972).

A second assumption is that the environments in which people live may be characterized by their resemblance to one or more same named model environments. For each type there is a related environment (Realistic, Investigative, Social, Conventional, Enterprising, and Artistic). The theory hypothesizes that Investigative types will seek out and enter Investigative occupations (environments) and that Artistic types will select Artistic occupations (environments). Existing evidence does indicate that individuals tend to choose college major environments and occupational environments consistent with their personal orientations (Holland, 1962, 1968; Lacey, 1971; Lopez, 1962; Osipow, 1970; Osipow, Ashby, and Wall, 1966; Gaffey and Walsh, submitted).

The third assumption is that congruent person-environment interactions (a Realistic personality type in a Realistic environment) lead to outcomes that are predictable and understandable from the knowledge of the personality types and the environmental models. The outcomes include vocational choice, vocational stability and achievement, personal stability, and satisfaction. Thus, Holland's Theory suggests that congruent person-environment relations are conducive to stability, achievement, and satisfaction. It is primarily this suggestion (hypothesis) that our work has explored through a number of studies, five of which I will discuss today.

The first study (with Russel, 1969) explored the differences reported in personal adjustment problems between freshmen students (male and female) who made a congruent college major choice and students who made an incongruent choice. The prediction was that individuals reporting congruent person-environment relations would tend to report fewer personal adjustment problems when compared to the incongruent groups.

The congruent and incongruent choice groups were defined according to Holland's theory. This definition of congruence used reported college major choice to define the environment and the Vocational Preference Inventory to define the student. A congruent college major choice was one that was consistent with the student's primary personality type (highest scale score) as operationally defined by the Vocational Preference Inventory. For example, a student reporting a college major choice (accounting) consistent with his peak score (Conventional) on the VPI was labeled congruent (identical one-letter codes). Thus, congruence was defined as consistence between what the student is doing (college major) and what the inventory (VPI) suggests he might be doing. An incongruent college major choice (music) was one that was not consistent with the primary personality type (Realistic) of the student.

A word more about the Vocational Preference Inventory does seem appropriate at this point. To operationalize his 6 personality types Holland developed the VPI (a personality inventory composed of occupational titles). Holland reasoned that preferences are related to personality, and preferences are related to interests. Therefore, interest must be related to personality; hence, interest inventories are personality inventories. Thus, the basic idea behind the VPI (which is composed of 160 occupational titles) is that preferences for occupations are expressions of personality. If an individual prefers a large number of occupations associated with a personality orientation this tells us something about his coping behavior and his dominant personality style. In general, the results of the validity studies (concurrent and predictive) lend support to the meaning attributed to the scales (Realistic, Investigative, Social, Conventional, Enterprising, and Artistic). Test-retest reliability coefficients are adequate.

In the first study with Russell personal adjustment was defined operationally with the Mooney Problem Checklist (Mooney and Gordon, 1950). The MPC was constructed to aid students in expressing their personal problems. To respond a student underlines problems which trouble him. The total number of reported problems was the score obtained for each student. No reliability and validity coefficients are reported for the MPC. The author believes the reliability and validity coefficients would be subject to error because of the change that takes place in the individual and the way he perceives his problems.

The sample for the study consisted of 65 third quarter freshmen female students and 59 third quarter freshmen male students in the Ohio State University residence halls. These students made up 4 groups--male and female congruent and male and female incongruent.

		Sex	
		Male	Female
Congruence	Congruent	N = 20	N = 30
	Incongruent	N = 39	N = 35

Three hypotheses were tested by means of analysis of variance for unequal numbers for the adjustment scores (1, the congruence hypothesis, 2, the sex hypothesis, and 3, the interaction between congruence and sex hypothesis). We were most interested in the congruence hypothesis. The findings revealed that students who made a congruent college major choice reported fewer personal adjustment problems than students who made an incongruent choice. This finding was significant for males and approached significance for females. The results are consistent with Holland's notion that congruent person-environment interactions are conducive to better maintenance of personal stability.

The second study (with Lewis, 1972) explored differences on personality variables between freshmen students who made congruent, incongruent, and this time we added an undecided group. Our thinking was that individuals reporting congruent person-environment relations would tend to be more personally stable when compared to the incongruent and the undecided groups.

The congruent and incongruent college major choice groups were operationally defined as in the previous study. The congruent groups were composed of students who reported a college major choice consistent with their primary personality type determined by the VPI. The incongruent groups were composed of students who reported a major inconsistent with their primary personality type. The undecided groups consisted of students who reported no major or indicated an undecided status.

The personality variables were operationally defined by the Omnibus Personality Inventory (Heist and Yonge, 1968). This we thought would be a more rigorous definition of personality than the Mooney Problem Checklist used in the previous study. The OPI is a personality inventory for "normal" students composed of 385 items. It consists of 14 scales designed to measure normal ego functioning and intellectual activity. Reliability coefficients (test-retest) range from .84 to .93 for college males. The time intervals between the two test administrations range between three and four weeks. The scales show evidence of concurrent and predictive validity.

		Male	Female
Congruence	Congruent	N = 37	N = 37
	Incongruent	N = 37	N = 37
	Undecided	N = 33	N = 33

The sample consisted of 214 male and female undergraduates (second quarter freshmen) from the General Psychology class. There were six groups--male and female congruent, male and female incongruent, and male and female undecided.

Again, three hypotheses were tested by means of analysis of variance for unequal numbers for each of the 14 personality variables (1, the congruence hypothesis, 2, the sex hypothesis, and 3, the interaction hypothesis.)

The results showed the test for the main effect of congruence to be significant ($p < .05$, .01) for four personality variables (Impulse Expression, Personal Integration, Anxiety Level, and Response Bias). In general, the findings suggested that congruent males reported being socially accepted, logical, analytical, in a state of well being, less anxious, and less impulsive than the other groups (particularly the undecided and incongruent male groups). The undecided males reported feeling socially alienated, tense, impulsive, imaginative, and distrustful in their relations with others. The incongruent males reported feelings of isolation, loneliness, and impulsivity. Thus, for congruent males the results tend to be consistent with Holland's notion that congruent person-environment relations are conducive to better maintenance of personal stability. Indirectly the findings further suggest that the congruent males tend to be more personally satisfied than the members of the other groups.

The third study with Osipow, (in press Journal of Research in Higher Education) was identical in design to the second study (Walsh and Lewis, 1972). This study explored differences on self-concept and vocational maturity variables between freshmen students who made congruent, incongruent, and undecided college major choices. The congruent, incongruent, and the undecided groups were defined as before.

The self-concept variables were defined by the Tennessee Self-Concept Scales (Fitts, 1965) which is composed of 100 items that the student uses to describe his picture of himself. The Tennessee consists of 27 scales, 14 of which were used in this study. Test-retest reliability coefficients for a sample of collge students over a two week period are generally in the 70's and 80's. The scales show evidence of validity.

The vocational maturity variable was operationally defined using two instruments the Career Questionnaire, Form IV (Super, Bohn, Forrest, Jordaan, Lindeman, and Thompson, 1971) and the Vocational Development Inventory (Crites, 1965).

The Career Questionnaire is designed to measure vocational decision making skills. It is composed of 93 items that the student uses to report his career thoughts and plans. The scoring procedure yields four such scores (Planning Orientation, Resources for Exploration, Information and Decision-making, and a Total Score). No estimates of reliability and validity are available at this time.

The Vocational Development Inventory is designed to measure beliefs and attitudes about career planning. The VDI is composed of two scales (Vocational Maturity and Vocational Deviation). Evidence suggests that the Vocational Maturity scale is reliable (test-retest) and valid.

The sample was composed of 162 male and female undergraduates (second quarter freshmen) from the General Psychology class. There were six groups--male and female congruent, male and female incongruent, and male and female undecided.

		Sex	
		Male	Female
Congruence	Congruent	N = 27	N = 27
	Incongruent	N = 27	N = 27
	Undecided	N = 27	N = 27

Three hypotheses were again tested using analysis of variance for equal numbers for each of the self-concept and vocational maturity variables. The test for the main effect of congruence was found to be significant ($p < .05, .01$) for three variables of the Career Questionnaire (Planning Orientation, Information and Decision Making, and Total Score) and for the Vocational Maturity scale of the Vocational Development Inventory. However none of the self-concept variables were found to be significant.

These findings suggested that congruent males and females tend to report more specificity in occupational planning and implementation of preferences through major field choice than the other groups (particularly the undecided male and female groups). Futhermore, the congruent male and female groups reported more knowledge and application of decision making skills and awareness of sources of occupational information. Thus, the congruent males and females seem to have a more stable college major choice. In essence, the evidence suggests that congruent person-environment relations are associated with vocational stability and maturity.

In sum the previous three studies suggest that congruent people (congruent person-environment relations) tend to have better maintenance of personal and vocational stability, more stable college major choices, and more vocational maturity than the incongruent and undecided people.

The next two studies are similar in design to the previous studies, but they are different: 1, these studies operationally defined the personality types and the concept of congruence using Holland's recently developed instrument, the Self-Directed Search; 2, one of these studies introduced the notion of levels of congruence; 3, one of these studies used an older sample of students.

Thus, the next study (4th) (with Howard, O'Brien, Santa-Maria, and Edmondson in press Journal of Vocational Behavior) explored differences on variables of satisfaction between freshmen who made congruent and incongruent college major choices.

The congruent and the incongruent groups were defined using the Self-Directed Search. In this definition of congruence current occupational choice was used to define environment instead of college major choice and the Self-Directed Search was used to define the personality type (student) instead of the VPI. Thus, a student whose current occupational choice (physician) was classified as Investigative (ISA) according to the SDS Occupation's Finder (Holland, 1970) and whose first letter in his SDS summary code (IRA) was I (Investigative) was called congruent. Thus, congruence was defined as consistence between what the student would like to do vocationally and what the inventory suggests he might do vocationally. The incongruent current occupational choice groups were composed of students who reported a job choice inconsistent with their primary personality type. For example, a student whose current job choice (accountant) was classified as Conventional (CES) and whose first letter in his summary code ESC was E (Enterprising) was called incongruent.

A brief description of the Self Directed Search may be helpful here. The SDS is a simulation of the vocational experience. The student independently (on his own) takes the inventory, scores it, profiles the results, and reviews an occupational file (the Occupations Finder) for occupational alternatives. Separate sections for Activities, Competencies, Occupations and Self-Ratings determine a person's resemblance to each type. Students are also asked to list their occupational daydreams (current occupational choices). The SDS yields a three letter summary code in which the three highest total scores are ranked in order. Two recent studies (O'Connell and Sedlacek, 1971; Zener and Schnuelle, 1972) show that the three letter codes are reliable. Holland would say that the construct and predictive validity of the scales and items are contained in the theoretical studies which stimulated the development of the instrument.

Satisfaction was operationally defined using the College Student Satisfaction Questionnaire, Form C (Starr, Betz, and Menne, 1971). On this instrument students are asked to report their thoughts about various aspects of their college. The questionnaire yields five scale scores and a Total Score. It is a reliable and valid measure.

The sample was composed of 140 male and female undergraduates (second quarter freshmen) from the General Psychology class. There were 4 groups--male and female congruent and male and female incongruent.

		Sex	
		Male	Female
Congruence	Congruent	N = 35	N = 35
	Incongruent	N = 35	N = 35

Three hypotheses were tested using analysis of variance for equal numbers for each of the satisfaction variables. However, in the test for the main effect of congruence none of the satisfaction variables were found to be significant.

Since none of the satisfaction variables were found to be significant, we did something we had not previously planned on. In order to increase group discriminatory power congruence was defined more rigorously. Congruence was defined as agreement between first and second letters of the current occupational choice code and first and second letters (same order) of the SDS summary code. For example, a student whose current job choice (physician) was classified as Investigative - Social (ISA) according to the SDS Occupations Finder and whose first and second letters of his SDS summary code (ISE were IS (Investigative - Social) was called congruent. The redefinition did reduce the sample size of each group.

		Sex	
		Male	Female
Congruence	Congruent	N = 16	N = 29
	Incongruent	N = 29	N = 29

Now the same three hypotheses were tested. This time the test for the main effect of congruence was found to be significant ($p < .05$) for four of the CSSQ scales (Working Conditions, Recognition, Quality of Education, and Total Satisfaction). On each of the scales the congruent male group had the highest mean score. The findings revealed that the congruent males reported more satisfaction with the physical condition of the college, with the accepting attitudes of faculty and students, and with the academic conditions associated with intellectual and vocational development than the incongruent females.

In summary, for congruent males (using the more rigorous definition of congruence) the results of this study are consistent with Holland's notion that congruent person-environment relations are conducive to greater satisfaction. The findings also suggest that there may be different levels of congruence such as three-letters identical, two-letters identical, one-letter identical, and no letters identical.

The fifth and final study (Walsh, in press Journal of Vocational Behavior) again explored differences on personality variables between upperclass students (not freshmen) who made congruent and incongruent occupational choices. The congruent and incongruent groups were defined as before (identical one-letter codes) using the SDS and current occupational choice.

The personality variables were defined by the Omnibus Personality Inventory (Heist and Yonge, 1968) and the California Psychological Inventory (Gough, 1957). Both are reliable and valid measures of personality. The OPI consists of 14 scales designed to measure ego functioning and intellectual activity. The CPI consists of 18 scales designed to measure characteristics important for social interaction.

The sample was small--59 males and females primarily upperclass students (4 sophomores, 24 juniors, 24 seniors, and 7 graduate students). There were again four groups--male and female congruent and male and female incongruent.

Congruence		Sex: Male	Sex: Female
Congruence	Congruent	N = 14	N = 11
	Incongruent	N = 21	N = 13

The findings showed the test for the main effect of congruence to be significant ($p < .05, .01$) for eight variables of the CPI (Dominance, Capacity for Status, Well-being, Responsibility, Self-control, Tolerance, Achievement via Conformance, and Intellectual Efficiency) and one variable (Personal Integration) of the OPI.

The findings showed that congruent males reported being more socially accepted, ambitious, planful, energetic, productive, valued intellectual achievement and work than the incongruent male and female groups. The incongruent males reported being self-confident, aggressive, impulsive, insecure, lonely, unambitious, and pessimistic about their occupational futures. The incongruent females tended to be retiring, conventional, insecure, lonely, restricted in interests, unambitious, and pessimistic about their occupation futures.

Thus, again these two studies using the SDS to operationalize the personality types and the concept of congruence suggest that the congruent people (particularly congruent males) tend to report more satisfaction and better maintenance of personal and vocation stability.

The applied tentative implication of this research is that students who have selected and are functioning in a college major (environment) consistent with their personal characteristics seem to be psychologically healthier than students who have selected a college major somewhat inconsistent with their personal characteristics or students who remain undecided. This implies that a realistic decision about college major choice early in the college years may contribute to psychological health and well-being for some of the personality types.

In terms of research implications, clearly the concept of congruence needs to be extended to the world of work. The need exists to explore differences (personality, vocational stability, satisfaction, and performance) between people who have entered congruent occupational environments, people who have entered incongruent occupational environments, and people who have entered no occupational environment. We hope this will be our next research task.

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A SYSTEM FOR DECISION-MAKING DEVELOPMENT DURING CAREER DEVELOPMENT[1]

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and
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Differentiating Career Choices

About two decades ago Dr. Denzel D. Smith was good enough to sponsor, through the Office of Naval Research, a series of studies of vocational development in which Tiedeman was engaged. Prior to that sponsorship, Tiedeman's colleague Dr. Joseph G.Bryan (1950) had defined and solved the multiple discriminant function problem. Professor Phillip J, Rulon and Tiedeman subsequently joined Dr. Bryan in exploring applications of multiple discriminant analysis. Rulon largely engaged in further methodological application (Rulon, Tiedeman, Tatsuoka, and Langmuir, 1967); Tiedeman mostly engaged in using multiple discriminant analysis in the study of vocational development.

Tiedeman's initial applications of multiple discriminant analysis was in the study of educational and vocational choices. A series of studies which he loosely bound together under the umbrella, Harvard Studies of Career Development (see Tiedeman and O'Hara, 1963, Section V, for history) began to indicate not alone the obvious fact that people who pursued one or another educational or occupational endeavor differed significantly at entries but also indicated the discriminatory canonical variation associated with that separation.

Tiedeman remained interested in describing the discriminating canonical variation but until recently left such descriptions to others. Roe's (1956) theory of occupational choice and Holland's (1959) theory of vocational choice in general dominate vocational psychology at the present time. Both theories essentially presume interaction of being and doing. A person is presumed both to be what he does and to do what he is. In these theories action is presumed to satisfy need. Our experience has also indicated that action engenders need as well. Roe (1957) has reverted to child rearing practices in search for origins of occupational needs. Holland (1966) relies on personality manifestations.

Project TALENT which Tiedeman directed from July 1971 until his resignation in August 1973 has the most convincing empirical data on differential origins of educational and occupational choices. Cooley and Lohnes (1968) describe the discriminating variance of the 109 high school antecedents of TALENT's subjects classified according to their career category five years after expected year of graduation. Cooley and Lohnes also began derivation of a career tree since the probabilistic nature of TALENT's stratified sampling of about five percent of America's 1960 high schools permits estimation of branching probabilities. Cooley and Lohnes' initial study of TALENT's five year career data was corroborated in study and report of another grade of data by Flanagan, Shaycoft, Richards, and Claudy (1971), In this study Flanagan (Flanagan et al., 1971, Ch. 6) also derived twelve groups of occupations which are logically and empirically homogeneous within groups but different from one group to another. Two lines of work are presently underway on the Flanagan career groups. In one instance, the career groups are being used as basis for report in a forthcoming Career Data Book (Flanagan, Tiedeman, and Willis, 1973) of the differentiated occupational profiles of TALENT's subjects. In the second instance, the stabilities of career choices one, five, and eleven years following expected year of graduation are being contrasted using the Roe, Holland, and Flanagan occupational classification system.

The Self Concept and Career Choice

Until 1971 Tiedeman had largely left description of discriminating occupational variability to others. Tiedeman did so because initial studies with his colleagues (e.g. Cass and Tiedeman, 1960) suggested that personality and interests generally dominated ability variables in discriminating educational and occupational groups. This result had the ring of reasonableness once known. Investment of one's time in educational and occupational work probably ought to be a more definite function of inclination or desire than of ability. There is hope that ability and activity conform but the person is probably much more likely to opt first for satisfaction of basic needs than for satisfaction of effectance needs. Persons have much more confidence than observers in their capacity to surmount the difficult. In many instances persons show up observers' doubts because learning while acting does occur.

The above observations led Tiedeman in the early 1950's to self concept as a potentially directing condition in occupational choice. Super (1953)had at about that time given the self concept central place in vocational development. Robert O'Hara joined Tiedeman first as a student and later as colleague in elaborating operation of the self concept in vocational development. O'Hara (1957) first logically differentiated the vocational area from Carl Roger's general theory of self concept development. He next operationalized vocational self conceptions and with Tiedeman (O'Hara and Tiedeman, 1959) published a paper on the possible developmental differentiation of vocational abilities, interests, and values during secondary school. Interestingly enough, O'Hara's initial formulations have so far withstood time pretty well. O'Hara has himself continued to find that self conceptions add to the variance of predicated educational success. Tierney and Herman are just publishing (1973) a verification study of O'Hara's and Tiedeman's developmental results. Their study does call one of O'Hara's and Tiedeman's earlier developmental conclusions into question once again. However, for the most part by omitting a ninth grade sample which O'Hara and Tiedeman had they lacked capacity to fully test the earlier results.

Self Concept and Career Development

In 1961-63, the College Entrance Examination Board gave Tiedeman and several others the opportunity to have an informal seminar on career development theory with expectation that several monographs on the subject would be published in order to point the way to further research. Professors Jean Jordaan and Donald Super published their essays from that seminar under title Self Concept Theory (Super, Starishevsky, Mathin, and Jordaan, 1963). O'Hara and Tiedeman published their essays as Career Development: Choice and Adjustment (1963).

In the Tiedeman and O'Hara essays, O'Hara and Tiedeman largely adapted Erikson's (1959) conception of ego-identity to vocational development. O'Hara largely differentiated vocational identity within ego-identity using Erikson's eight stages. As he had done earlier, Tiedeman (1961) largely first adapted Super's life-developmental framework of career stages to the case of a single decision in career choice and then proposed that career development took place within the union of career choices within the several career decisions constituting career development in their totality. Thus Tiedeman in effect proposed that the micro stages of a single career decision unite throughout the life into the macro stages of career development. An analogue could be the layers of an onion: each onion layer constitutes a ring; the rings in their totality constitute the onion.

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Tiedeman and O'Hara (1963) *employed the logic of decision making to propose a linguistic framework within which comprehension of decision making emerges during incidents of career choice. Essentially, their framework first divided the process of decision making into two aspects, anticipation and accommodation. The anticipation aspect consists essentially of a person's preoccupation with the pieces (facts, alternatives, options, consequences) out of which a decision is to be fashioned and with the aspirations, hopes, expectations, constraints, and the like which will determine the form of the decision. The accommodation aspect represents the movement from anticipation to induction; it is the point where imagination meets reality. In the case of both anticipation and accommodation, it is possible to speak about "subaspects" or stages.*

Anticipation

The first stage of anticipation called exploration begins with a person's awareness "that a problem does or will exist and that a decision must be reached in order to resolve it in a satisfying manner" (p. 38). In discussing exploration, Tiedeman and O'Hara state:

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The part of this paper that is set off in *script* has been approved for publication by Love Publishing Company, November 8, 1973.

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> "In the step of exploration. . . a number of different alternatives or possible goals. . .may be considered. Relevant goals are those which can possibly be attained from the opportunities associated with the problem under consideration. . . . During the exploratory step, fields are relatively transitory, highly imaginary (perhaps even fantastic), and not necessarily related one to the other. They may be a relatively unassociated set of possibilities and consequences. . . . In the step of exploration in relation to a problem of career development, a person probably reflects at least upon his aspiration, opportunity both now and in the future, interest, capability, distasteful requirements that still can be tolerated, and societal context for himself and his dependents. These are relevant aspects of the field set by each goal. In short, each alternative as he senses it (pp. 38 & 41)."

Of crystallization, the second stage of anticipation, they assert:

> "In (crystallization) the cost of the several goals can be considered in relation to the return from each. The value of alternatives can then be assessed. Relevant considerations in relation to each of the goals as crystallization occurs. . . . Crystallization normally represents a stabilization of thought. A setting of thought is achieved which is ordinarily of some durability and hence of some reliance. This set readies the person for investment of self along a line that then becomes more noticeable. The situation becomes defined, so to speak, at least for a time (p. 41)."

The third stage is that of choice, and it follows readily on the heels of crystallization.

> "With choice, a particular goal, and its relevant field. . . . . orients the behavioral system of the person of relevance for his problem. . . . This goal may be elected with varying degrees of certainty and its motive power will vary as a result. . . . Furthermore, the degrees of clarity, complexity, and freedom generally available to the person in the solution of this problem and in the pursuit of the indicated decision will also effect the motivating power of the resulting resolution of alternatives (p. 42)."

The fourth and final stage of anticipation is called clarification. You would expect once a choice had been made that aspects of decision making which precede action would have been finished. But even though the decision is made and held firmly, often doubt about the decision will arise. This is true. . ."

> "in even a short period of waiting (a week or more, say) for the expected situation to begin to unfold. . . . Doubt experienced in the waiting period causes the individual further to clarify his anticipated position. An elaboration and perfection of the image of the future. . .ensues. . . .Clarification not only perfects the image of self in position, but also dissipates some of the former doubts concerning the decision (p. 43).

Accommodation

The three stages of accommodation may be briefly described in the following way:

> "Induction: A general defense of self and a giving up of an aspect of self to group purpose . . . the individual's goal and field assimilatively become a part of the region . . . of the social system in which the person is implementing his desired solution of his problem. He learns the premises and structures-in-interaction required for continued identification. This process leads to a further perfection of individual goal and field in the social system. . ."

> "Reformation: The receptive orientation of induction (gives). . . way to (an) assertive orientation. . . . The person is well immersed in a relevant group . . . . He has a strong sense of self and actively enjoins the group to do better. . . . Since. . .the person acts both upon the in-group goal and field. . .in order to bring that group into greater conformance with his modified goal and field. . .and upon the out-group to bring their view of his identification into greater consistency with his, the effect, if any, is the modification of group goal and field. . ."

> "Integration: Synthesis is, of course, the essence of integration. . . . A differentiation in identification has been achieved. The new-found appreciation of self is integrated with its larger field. This new part of the self-system becomes a working member of the whole self-system. In integration, individual and group both strive to keep the resulting organization of collaborative activity . . . . The individual is satisfied, at least temporarily, when integration occurs (p. 44)."

The above two aspects and seven stages have their general origin from logic and from Super's (1957) theory of career development. Harren

(1966) has additionally made an ingenious empirical application in which advance of vocational decisions up the steps of the Tiedeman stages was shown to be associated with year in college.

However, the above formulation has two limitations that shall be removed in this paper. First, since it was a language predicated on the application of Super's 1957 theory of vocational development to a particular vocational decision, it somewhat clumsily incorporates the macro conditions of a single vocational decision which is only a part of that lifetime vocational development. Second, since it was language predicated on the assumption that the individual cannot be a part of self science, it talks about decision--it does not talk about the person comprehending while making decisions. Therefore, choice will be discussed generically and how it relates to the person deciding.

Selfhood and Career Choosing

Tiedeman and O'Hara subsequently moved beyond their 1963 centering of decision-making development in the process of identity formation (cf. Tiedeman, 1967, 1968, 1969). Their early union of decision making with identity formation made a tentative place for self-comprehension in career development. Their work with others, particularly Kehas (1964) first clarified the relationship between self conceptions and self concept thereby recentering interest on selfhood as the principal product of career development. Field (1964) next introduced a philosophically and empirically consistent concept of purpose as the mechanism potentially guiding career development. According to Tiedeman and Field (1962):

> "We believe that to establish purpose in Guidance, ends must come into existence before, or simultaneously with, means. This premise does not involve the issue of teleology, as might be argued. A goal, if defined as 'a desired future state,' certainly cannot exist prior to the means for its achievement. But a concept of this desired future state can exist in the present. Thus it is quite possible to compare the present state of X with the concept of a future state of X, to note the difference, and to choose, develop, modify and perform a series of actions designed to reduce this difference."
>
> "This process is what we mean by the term 'purposeful action.' It describes:
>
> 1. the behavior we hope to encourage on the part of individual students;
> 2. the behavior we hope to make more practicable for individual Guidance professionals in education; and,
> 3. the behavior we hope to make more operational in training such professionals through the mutual development of professional theory."
>
> "Thus 'purposeful' means 'not random,' i.e., 'more likely to achieve the currently desired by acting contingently upon the currently observed.' It is our current observation that contemporary activity in education is undesirably random in general and undesirably constricted in particular instances." (pp. 489-490)

Finally, Field, Kehas, and Tiedeman (1963) put their work together to make the person become not along the agent of his career development but to offer the possibility that the person can through the simultaneous hierarchical restructuring of the self enlarge his selfhood as well. This latter effect stems from simultaneous comprehension of decision making development during career decision making. Achievement of this effect by the person without the shackles of language or expectations of others requires hierarchical restructuring of self comprehension in the process. Why and how?

Allan Ellis in designing and in preliminarily testing the Harvard-NEEDS-Newton Information System for Vocational Decisions on which He worked with Tiedeman and O'Hara and others provided explicit statement of the extra-corporeal relationship which is needed to comprehend those parts of self which are known to others but not to self (Fuller, Bown and Peck, 1967). Heretofore, there has not been an explicit statement of the ultimate in self centering--the taking of even more appropriate responsibility for one's decision making in growing awareness--during decision-making development.

Tiedeman saw this relationship through a glass darkly in his 1963 monograph with O'Hara. At that time he realized that the stage of integration came from the perspective of rejoining the newly differentiated concept of self with the larger gestalt of self. However, as indicated above, Tiedeman was at that time trying to be completely objective about this process. He did not realize that the concept of self centering in decision-making development requires the abjectification of experience for another without his concommitant subjectification to the concepts or language of that objectification.

Ellis and Tiedeman (1969) contend that the problem of objectifying the experience for another without subjecting him to the objectifying concepts is the central problem. They argue:

> There is something peculiar about (Tiedeman's and O'Hara's) paradigm, a potential difficulty quite similar to the problems we sometimes get into when we use language. A peculiarity of language known to philosophers for some time is that among the things we use language to talk about is language itself. Bertrand Russell, for example, has shown that it is a case of bad philosophical syntax to assert something like, 'The golden

mountain does not exist,' and from that suppose you are attributing some kind of existence to the very thing whose existence is denied in the sentence. As language does sometimes, the paradigm of decision making turns back onto itself in a way we must be clear about. Not only does the paradigm depict the decision process, it also by this depiction prescribes how one should relate to that process. That is, in enunciating the aspect of accommodation, the paradigm argues that one of the things to which one must accommodate is the decision process itself. But integration is the development of meaning that is independent of language as the instrument of that meaning. Thus, the language of decision making, even though it is the medium through which understanding of the process comes, must be thrown off before the accommodation is complete.

This throwing off - perhaps making invisible is a better thing to say - of the instrument of meaning (suggests the needed play) between the external and the internal imposition of form. . . .Accommodation to decision making itself is the most general kind, since it represents internalization of the processes of resolution. First the language must be established for the individuals (induction), then it must itself become an object of analysis (reformation),and finally it must dissolve, as the individual goes past it to meaning (integration).

By way of the essentially artistic activity (of counseling), the counselor must take his client through these phases, not with respect to a particular problem so much as with respect to the process itself. He must establish the client's proficiency in the language of the process, develop his

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> awareness of this language and its effects and, in the end, facilitate the individual's internalization of this process. In doing this, we argue that the counselor leaves the client with a sense of agency as a logical consequence. The state in which one believes himself to be a significant agent in determining what happens to him comes not from convincing him about it but from the internalization of the decision process (pp. 24-25)."

This is our swing point, the point which moves us from the old to the new. As we generalize the condition of using language to explain without determining, we abandon two heretofore limiting concepts-namely, (1) using something as general as thought-guided action only in the small context of career, and (2) limiting ourselves to the relationship of man and machine as Ellis and Tiedeman did in conceiving action in the larger context of comprehending responsibility for guiding one's action by thought. We, therefore, abandon guidance-in-education for guidance-in-learning as Tiedeman recently did (1972) and as Marland advocates in his concept of Career Education (1972).

THE MILLER-TIEDEMAN GRAMMAR OF DECISION MAKING

Tiedeman and O'Hara laid out decision-making development as it can be seen by another when the person talks about his deciding. Tiedeman and Ellis laid out the language difficulty which arises when you help another see what you do about his decision-making development. We now seek to avoid that language difficulty by indicating how you can help another verbalize what you see happening to him. However, in doing so, you must take pains to see that he knows what that language means for himself not just for you. Otherwise, he has your language--not his comprehension--of what and how he experiences. As one helping another, you must cause a larger perspective than just the decision itself to be seen. That is, you must cause the person to see himself deciding (Miller, 1971). You must recognize that the WHAT of decision must ordinarily precede the WHY of decision.

Tiedeman, O'Hara and Ellis differentiated the WHAT, HOW and WHY of decisions as they planned the Information Systems for Vocational Decision (ISVD). The very way in which the computer must be programmed for personally-directed inquiry forces the programmer to expect a different response when a student is exploring in the System than when he is clarifying a decision in the System. In the former condition, the System must be programmed so that the student (1) may go from option to option at will, (2) experience generality without too much detail, and (3) not be held accountable for knowing before he and the System agree that he knows WHAT. In writing about the ISVD, Tiedeman always distinguished these two subaspects of the Tiedeman and O'Hara Anticipatory Phase of decision-making as EXPLORATION (which includes exploration and crystallization of the decision-making paradigm) and CLARIFICATION (which includes its choice and clarification stages). The names were kept the same as two of the steps in the paradigm because they had similar properties, but the designation was differentiated so that the programming--or, in reality, the inquirer's psychological states of EXPLORATION and CLARIFICATION--could be denotatively distinguished from the logical conditions of their analogous exploration and clarification steps.

Wilson (1971) subsequently elaborated the ISVD concepts in relation to the System's intent to help another comprehend himself in deciding. Wilson postulated and demonstrated that three levels of activity occur in the teaching of decision making.

> Level I, "learning about," concerns cognitive awareness of decision making which is obtained through verbal, abstract means. Level II, "doing" involves both cognitive and non-cognitive awareness which are developed by making decisions and feeling both the interplay of factors going into a decision and the impact of that decision on subsequent ones. Level III, "doing with awareness," flows from the awareness of the personal criteria used to establish priorities among conflicting values and the characteristic pattern of the

individually determined history of deciding (pp. 24-25).

MILLER-TIEDEMAN CUBISTIC MODEL

The new Miller-Tiedeman cubistic model of decision making draws together three new basic elements--the psychological, problem, and self-conceptualizing states. This model is predicated on the fact that the "known behavior of the whole and the known behavior of a minimum of known parts often makes possible the discovery of the values of the remaining parts, as does the known sum of the angles of a triangle plus the known behavior of three of its six parts make possible evaluating the others. Topology provides the synergetic means of ascertaining the values of any system of experiences" (Fuller, 1969, p. 73). Accordingly, we move our discussion from the part (choice in career) to the whole (choice in life) in which choice in career inheres. Even though the configuration in the Anticipation Phase remains the same, the content is expanded to include two psychological states: (1) the problem-forming state (the psychological state of EXPLORATION in the vicarious part of the Anticipation Phase) and (2) the problem-solving state (the psychological state of CLARIFICATION in the acting out part of the Anticipation Phase). The third psychological state, solution using, is manifest in the Accommodation Phase. Solution using in the Accommodation Phase retains the induction, reformation and integration substages, but the content of these stages focuses on conditions surrounding generic decision making as opposed to career decision making. However, the existing content relative to a career decision remains valid when one is involved in a career decision, as Tiedeman originally intended.

Problem-forming Activity

In problem-forming activity (Anticipation Phase), the individual experiences vicariously all four stages of the decision-making paradigm: (1) exploration, (2) crystallization, (3) choice, and (4) clarification. In so doing, he incorporates the decision-making skills or strategies:

(1) defining the problem, (2) collecting information, (3) weighing alternatives, and (4) making choice.

The hallmark of problem-forming activity is the gestalt of something which is being sought but cannot yet be fully articulated. In this activity, the person permits himself to be disturbed by the inconsistency in something he has observed and something he wants. He suspends direct thinking. He lets his imagination have play. His mind wanders to secure that "theory of the whole" which eludes him as he "knows" but cannot articulate. As Polanyi (1966) indicates about the tacit dimension in problem-forming activity, the person seeks to make his comprehension move from the here of now to the there of then; the person himself bridges those two conditions in his comprehension. Problem forming may well require a week, a month, a quarter, a year or even more for incubation. The person does not readily define himself in his environmental situation as if there were a problem which he comprehends. It takes leisure. It takes thought. It takes contemplation. It takes attention. It takes time. It takes guts.

In problem forming, the person engages only in simulated intellectual activity about his problem. But notice that we have brought the so-called "decision-making skills" into the four decision-making stages as a natural adjunct. We did so because we believe that knowing the logical sequences of steps alone in the problem-solving activity will not result in knowledgeable decisions. In the decision-making realm, Coleman (1970) suggests:

> In a simulation or game, the student may learn to perform very well in a given decision-making capacity yet not be able to verbalize what all must go into his action. In learning the same material from books, a student may be able to describe what elements go into a given decision but not be able to make such a decision correctly (p. 15).

Consequently, we believe that there is more to the decision-making phenomenon than simply knowing the logic or steps in a decision-making process. That is why we have nested those steps in the"decision-making process" as part of the problem-forming and -solving activity rather than as a separate learning exercise placed out of context with the material to which it relates. The emphasis is on learning while experiencing the total process, not just a part of it.

Recognition of the four decision-making stages while vicariously experiencing the process of decision making helps improve decisions. Experiencing the four stages while not acting on the vicarious choice for a few hours, a day or a week allows one to check to see if this is a "driven decision" or a "purposely chosen one," because in a driven decision--after the initial wave of desire subsides--there is no choice as the desire has faded. The vicarious experience provides a check for various types of decision makers.

Problem-solving Activity

Problem forming and solving have their watershed at the point when the person moves from imagining his "theory of the whole" to putting one or more aspects of that "theory" to the test. While the hallmark of problem-forming activity is the gestalt of something which is being sought but cannot be fully articulated, the hallmark of problem-solving activity is that very articulation itself. In problem solving, those things that belong with the "theory of the whole" must be assimilated to it; the mind must find ways to put them together as parts into the whole which is imagined.

In the Miller-Teedeman cubistic model of the decision-making process we propose that this articulatory process needs anchoring in the self process of explaining to another. Therefore, the further hallmark of problem-solving activity in this grammar is 'problem solving while learning about one's self from another' as in Career Education. This necessitates the use of current experience with both bad and good decisions. These decisions become pivotal in learning about yourself from another. As we learn to talk about both bad and good decisions that we encounter in everyday life and to be more efficient with the decisions, then we can

> *improve our low-risk and low-cost decisions which, in turn, will prepare us to better handle those decisions with high risk and high cost.*
>
> *After the problem-forming state is experienced, the decision process is fully re-enacted. But in problem-solving activity, the decision is acted out at the choice point; the decision is put to the test again and again allowing the individual to experience at least twice the clarification stage in deciding. However, during the problem-solving state, we believe it is important to show another what he is doing while he is doing it. This is where Miller's (1971) idea of the person-to-person interaction needed for centering the problem-solving process in the self becomes important. Here one person teaching another person can further elucidate the WHAT in the problem-forming process as well as the HOW in the problem-solving process with that individual. When another can assist us to "do with awareness," we can focus on our behavior in the problem-forming as well as in the problem-solving phases and know what it is that we did that made the choice satisfying and/or dissatisfying. Then, making a choice which makes our life different becomes something we feel we do for our self-enchancement. We then begin to feel a sense of internal control. However, what we are attempting to do in talking about person-to-person interaction is to create in the Anticipation Phase opportunities for introducing this social act of seeing yourself as others will see you in relationship to what you are telling them you seek in the Accommodation Phase. This is an act which we no longer feel has to be reserved for the professional counselor. The act of helping another see himself is a primary skill in learning this valuing process with self. We try to give that experience to students when they are helping another see himself. Essentially, we find out some of what is unknown to us (but known to another) in the interaction with another.*

Case Study. The new use of the Tiedeman paradigm of decision making is illustrated in the following case.

> *At 26 Sharon had a master's degree and felt very capable in most areas of living. She*

began to identify herself as an impulsive decision maker when her fiance started to validate her decisions for her. She then identified several decisions that had not turned out too well. She recognized, for example, that she had a lot of items in her closets and household that she did not wear and did not like. She was not disturbed by this situation too much at first, so she dismissed her discontent. Since she always had money to spend, she did not have to be careful about her buying.

Sharon married a year later, and her financial status changed considerably. She did not have as much money to spend. Consequently, she began to look at her general decision-making habits. Her busband began to complain about the excess. He pointed out to her how much she bought but really did not need, how much make-up she purchased but did not use often, how many clothes she wore once or twice then ignored because she grew tired of them, how many wigs she bought but only wore occasionally. Then she began to notice her present situation--how many things she thought she wanted, but did not after a week's wait. The dawning realization that what she thought she wanted at the moment was not always satisfying in the long run caused Sharon to recognize her style of decision making, and she was able to change her behavior. This change was based on the fact that she was now able to identify more of her impulses as she experienced them. But, though she still experiences desires as before, she now recognizes they may be only whims that will pass. She can now wait to see. This behavior generalized to her career decisions as well.

After being married several months, Sharon began to seek employment in her field of training, sociology. However, jobs in sociology were not plentiful in her area. She also had training in business which gave her a secondary skill. The salaries being offered for these jobs were good, from $800 to $1400 a month. At first she became excited about the money, then began to realize that money was not all important, that other factors needed consideration. Before her recognition of style in her decision making, she would probably have accepted a job based on her first impulse about the job, salary. But the awareness of her impulsive nature in decision making now made her cautious about deciding quickly. She did not want a job whose attraction might fade, thereby necessitating renewed job hunting. So she pursued the market further (something she would not have done before). She searched out her possibilities, learned alternatives. At the point where the decision is usually made, she hesitated based on her knowledge of her previous style of decision making--impulses resulting in later unwanted excess. She recycled and waited until she felt intuitively as well as informationally good about a job and until the desire remained constant. She then made the decision to take a job with a juvenile bureau where she could work with delinquent boys.

Note that Sharon used the steps in the decision-making process in the natural activity of making her vocational decision (i.e. define her problem, collect information, weigh alternatives, and ultimately choose). The important fact is that she withheld a decision even though many of the jobs appealed to her and her old impulse would have been to accept. Instead she waited, talked with her husband and friends, then acted out her choice (problem solving). In other words, she remained in the problem-forming state, keeping in mind her style of decision making; and on recycling when her desire remained constant, she selected the juvenile job instead of being impulsively driven to that decision. She thus fulfilled the "doing with awareness" step in Wilson's scheme of decision making (Wilson, 1971). The behavior generalized, and she is now more deliberate about her decisions--seeing if possibilities appeal to her later as well as immediately (solution using).

The above case illustrates the fact that an individual not only needs to know the steps in the decision-making process, but also needs to center on his "self" doing in order to learn his style of decision making. Then the steps in the process become a powerful tool in learning about his style. If it is accepted that decision-making style is the end gain and the

> decision-making process the means whereby, then we must develop the means to teach understanding of style in relationship to the specific decision-making processes.

Awareness of Style. In discussing the rational and nonrational factors of problem solving, one must rely on some accepted theories of teaching which are based on the assumption that through specified behavior one can stimulate a person's interactions with material with fairly predictable outcomes. If this is accepted, it can be assumed that the teacher may succeed in

> initiating processes which aid recognition of style with the person. When specific behavior occurs, one sometimes can succeed in causing an individual to attend to those behaviors as they occur. Ultimately, when that condition exists, a skilled "co-experiencer" has the opportunity to create a triple effect: (1) providing the language framework necessary for the individual learner to comprehend more completely his behavior (both current and past) by introducing the appropriate formal statements about the decision-forming process; (2) illuminating the existing decision-making steps underway within the individual at that moment and simultaneously relating these present behaviors to the individual's prior comprehension of similar former behaviors; and (3) encouraging the individual who is at that point gaining insights into his past and momentary behavior to (a) think ahead, (b) specify potential means of satisfying future needs which now are better understood (c) create his own plan for fulfilling future ends of which he is now more aware, and (d) implement his then created decision with the realization that his actual future self-structure is now more fully known.
>
> However, the informal co-investigation of present decision making in a personal, differentiated, and hierarchically integrated framework of process implies that the decision-making processes are only relevant as they relate directly to the person making the decision at that point in time. It also suggesis that the crucial issue is not the fact that the student academically knows the steps in the process but that he knows where and how to fit them into his momentary experiencing, what behavior ensues as a result, and how satisfying this behavior is to the person. This makes the steps

> useful as he then is able to integrate them into his individual framework. Relevant to this point, Simon and Newell (1971) suggest that we must learn "how changes in the attendant condition--both changes inside the problem solver and changes in the task confronting him--alter problem-solving behavior" (p. 145). Explaining these processes requires emphasis on HOW particular human behavior comes about and WHAT mechanism causes it to happen. Awareness of these conditions adds new dimensions to the problem-forming and problem-solving activity and to decision making itself. Note in the case study that the HOW occurred when Sharon began to understand that many items were accumulating which served no practical purpose to her. The WHAT occurred when she began to understand while she was feeling the impulse that its desirability may not last with time; therefore, she was actually forming another decision set which was hierarchical to the first one.
>
> Solution Using
>
> Problem solving and solution using, in turn, have their watershed at that point when the person puts his solution to use. The psychological states which are critical in

solution using (in the autonomous Accommodation Phase) are those of induction, reformation and integration in the Tiedeman-O'Hara paradigm of decision-making development. The content of these substages will be the same for career decision but will be changed as follows for choice in general.

> A solution is presumed to have been invented and put to preliminary test before it is brought into repeated use in solution using. In the repeated use of solution using, the person first remains hesitant because his problem solution hasn't been tried extensively. The person, therefore, maintains the inductive state of being somewhat more other-directed than usual. However, as the person experiences repeated successes with his solution, he moves from the stage of induction into that of reformation. He has the swelled confidence of success and power over others because of a desired solution which works. But reformation ordinarily does not persevere forever. The person himself becomes aware of situations when the expected

fails to materialize. The person becomes aware of pattern in his activity. The person becomes aware of potential harm and subjugation which he causes by his solution. All these conditions tend to move the seemingly settled into a condition of further unsettlement and cause the person to go over his decision several times and, thereby, get a hierarachically restructured solution and sense of self. These new differentiations help reintegrate the old differentiation with its totality of being. The person in this integration gains perspective upon his decision and, in that perspective, upon himself as well.

In the Miller-Tiedeman cubistic model of the decision process, solution using is marked by aid-free activity. Whereas we have emphasized vicarious experience as necessary in problem-forming activity and conversation with another while explaining what one knows in problem-solving activity, we have not introduced such props in solution-using activity. Solution-using activity occurs in the natural state. Solution-using activity occurs when the person believes he knows something and takes off with it of his own accord and guidance. Solution-using activity occurs when articulation has been so internalized that the person considers himself in control and goes alone to test that assumption. There are still times of doubt as the person inducts himself and then enters into reformation as he proclaims his knowing before the world. But in solution using, the processes of doubt resolution have been internalized. As Ellis and Tideman (1969) wished:

> First the language must be established for the individual (induction), then it must itself become an object of analysis (reformation), and finally it must dissolve as the individual goes past it to meaning (integration) (p. 25).

The Cubistic Grammar

The Miller-Tideman cubistic model of decision making is the grammar of the needed language which encourages comprehension of self in the decision-making process. The language of decision making is established vicariously with the person while he is problem forming, it becomes an object of analysis with another as the person is problem solving, and the individual goes past it to meaning in his own solution using.

The cubistic model (see Figure 1) unites the three conditions inherent in the decision process--problem condition, psychological state, and self-comprehension. The counselor must learn to keep all 27 (3x3x3) combinations of this cubistic model in mind as he, in turn, helps students also gain such comprehension so that they may engage in decision making for themselves with self-understanding, not self-abnegation.

Notice how tortuously the person progresses in gaining understanding of himself in thinking while acting. The simplest condition for the person is that in the extreme lower-left cell of the cube. In this condition, the individual problem forms during EXPLORATION in the vicarious part of the Anticipation Phase; and he succeeds in "learning about." But by moving through the psychological states, he moves his problem-forming activity to solution-using activity thereby progressing to the upper-right, rearmost cell-- solution with self awareness in the state of ACCOMMODATION.

This theory is different from what we ordinarily understand theory to be in psychology. Ours is not a theory which allows another to predict the behavior of a subject. Instead, ours is a theory which allows a person to put his own decision-making activity into perspective for himself. As such, the theory is merely a description of what can be internally experienced. However, as the individual understands this cubistic grammar of what goes on as he centers upon himself in thinking while acting, he gains more and more power to guide his action by thought with practiced ease.

Unfortunately, we have no easy nostrums to offer about how the conditions of guiding action by thought with practiced ease matures in the person. However, we do have a number of suggestions for how it might be helped to mature.

A major research area in decision making development is the objective definition of that development. At this time a definition of the needed objective cannot be offered. It is suspected that the stages may be or resemble either Kohlberg's (1964) stages of ethical development or Perry's (1970) stages of character development. Tiedeman is presently engaged with John Peatling, Union College Character Research Project, in introducing a mathematical group theory of personality constructionism as philosophical foundation for what is considered to be the realization which is ultimately developed.

Investigation of the expected development proceeds within a framework in which the individual develops comprehension in a responding environment which offers him help but holds him accountable and responsible for intentions and their caused actions. Formally defined are the needed responding environment elsewhere (Tiedeman and Miller, 1973). Tiedeman (1972) has also outlined the problem of comprehending hierarchical self restructuring in the presence of the needed responding environment. In these two papers, a person formally interacting in a computer environment programmed to help him comprehend self while comprehending what he seeks to decide is chosen as the means of beginning specification of what will be needed for later scientific investigations which will help him mature in self comprehension.

Teaching About Decision Making

In applying this theory, one runs into the problem of how it is supposed to work as opposed to how it does work. What is about to be proposed is how it is supposed to work. It won't be known until at least the end of next year

how it does work; but until we acquire further information about it, we will share our present thinking--cautioning you to temper it by your own experiences and judgment.

Several important assumptions underlie our cubistic model of decision making, namely:

1. The desired end state of the process is living in awareness the realization that man consists of systems, exists in systems, but becomes himself in transcending systems. Personhood must be construed as an open system.

2. Elements and relationships are together the fundamental components of the open systems lived in the desired end state.

3. Hierarchical structuring is necessary in transcending open systems. The self must be put into relationship with internal and external open systems as if the person can comprehend the self's position in both internal and external systems.

4. Change of a hierarchically structured but open self system is achieved by hierarchical restructuring of the self. The opened self has to be put into different relationship with old comprehension of internal and external systems. Integration to a new whole has to take place. Differentiation of old and new parts has to ensue. Re-integration of the newly differentiated and the new whole has to happen.

5. In order to accomplish hierarchical restructuring of self with intention, the person must come to operate his open self system in awareness. The person must be able to think and act as a self system in order to achieve hierarchical restructuring of his self system. The person must come to know the antagonistic nature of possibilities and progress. Possibilities are entertained at the expense of progress; progress is achieved with the personal limitation of possibilities. Progressive hierarchical self restructuring in an opening self system requires a solution in which a synergy of possibilities and progress is attained. Interactive, not singular, pursuit of possibilities and progress is needed. The fluid self must be permitted ebb and flow as goals and actions shift under changing purposes. A discontinuity in situations must be borne with the introduction of some self discontinuity into an otherwise continuously existing self system.

6. Help may be extended a person in opening his self system for hierarchically restructuring. The needed help must be tendered in the form of scaffolding which permits helpers to construct buildings but results in elimination of later unneeded scaffolds as the new structures formed in construction take shape and later prove able to fulfill their functions without help. Provision of such a scaffold-like adjuvant relationship in which the helper is able in time to remove himself from the structure he has helped to build is essential for eventual achievement of the thought and life style set out above. "Teaching" decision making in this adjuvant way is possible if structured with the care outlined below.

7. Decision making per se does not have to be taught (Wilson, 1971). However, decision making can be improved by learning from your own decisions (a) the stages your decisions go through, (b) the skills you use in those stages, and (c) your style of decision making. [Dinklage (1969) found that 25 percent of the adolescents she worked with were making "planned" decisions. Therefore, it may be that some seamen will not need this type of training.]

8. For the most part seamen need to use their own behavior--not another's--as a base for learning. However, this does not preclude the use of simulation.

9. Understanding of problem-forming, problem-solving and solution-using states will significantly improve the individual's satisfaction with his decision.

10. Improvement of low-risk, low-cost decisions will generalize to high-risk, high-cost decisions.

11. There are "one-shot" decisions for which an individual needs specific information, e.g., house-buying. In house buying an individual could make a bad decision, regardless of how many strategies or skills he had. Information about such high-cost decisions is difficult to obtain. Therefore, information of this kind should be given to the seaman.

> The *parts for the teaching of our proposed cubistic model of decision making are all around you. Before you begin your teaching of another, assure him that he knows how to make decisions, that he does it everyday. Together, you may be able to improve this decision-making ability which, in turn, would save him time and money and give him a sense of being in control and a deliberate, considered person.*

It is important that you get the seaman to think aloud as he makes his decision (any decision). By listening to the seaman's verbalizations, you can begin identifying his present problem condition. Try to do so unobtrusively, merely indicating that you are giving a name to something he is doing so both of you can return to it. When you do go back later, seek to elaborate the person's decision-making vocabulary in each of three psychological states.

Problem-Forming State: EXPLORATION Substage

In this state, teaching about choice begins with (1) ways of making a choice, (2) the stages one moves through in a choice, (3) strategies (style of decision making), and (4) skills involved. This stage is analogous to learning the parts of the body in order to make a knowledgeable medical diagnosis. The learning of the parts of decision making is useful to everyone since it is a continuous daily activity for persons of all ages and in all socioeconomic levels. Therefore, learning about decision making is as germane to aduts as to youth.

The problem-forming state consists of the person's awareness that a problem does or will exist and that a decision must be reached in order to resolve the problem in a satisfying manner.

> *Exploration. In this step, Tiedeman & O'Hara (1963) consider a number of different goals:*
>
> *Relevant goals are those which can possibly be attained from the opportunities associated with the problem under consideration .... In the step of exploration ... a person can, in imagination,*

> conceive premises, structures-in-interaction, and the effect that the presumably needed premises may have upon him. It is these premises about self-in-situation and the person's attitude (or posture) toward each that we intend to denote by the term psychological field (pp. 38-39).

Exercise: Have the seaman write down a decision he is going to face. (Explain skill: "defining the problem.") Have him list the end-gain or goal.

> Crystallization.
>
> Distinctions or differences merge from the comparison of at least two sets or fields.... The advantages and disadvantages can be ascertained. The cost of the several goals can be considered in relation to the return from each. The value of alternatives can then be assessed (p. 41).

Exercise: Have the seaman collect information related to his defined problem, then have him look at the alternatives. (Explain as skills.)

> Choice.
>
> As crystallization occurs, choice or decision follows readily. With choice, a particular goal and its relevant field orients the behavioral system of the person of relevance for his problem (p. 42).

Exercise: Have the seaman make a choice but emphasize that this choice is still only to be written on paper, not acted out.

Clarification. This is the critical point where the person begins to think more seriously about his choice. If the commitment is strong, then little change is likely to ensue.

> Otherwise, doubt about the decision is likely to arise in even a short-period of waiting (a week or more, say) for the expected situation to begin to unfold. This is particularly true when the attention of the person may be attracted to more information of relevance to his

> *decision in the course of waiting (or the desire has faded). Doubt experienced in the waiting period causes the individual further to clarify his anticipated position. An elaboration and perfection of the image of the future ensues (p. 43).*

Exercise: Have the seaman look at his choice, think about it for at least a week (if possible), talk it over (if he wishes) with friends, parents, and the like. However, the seaman is still clarifying a vicarious choice; he has not acted it out. Acting out is a problem-solving activity.

At this point, also, the seaman looks at his choice in terms of what he values. The Gelette-Varenhorst-Carey (1972) decision-making materials, dealing with values, may be adapted for use in this substage. Also, the seaman has not yet become concerned with his style of decision making, just the fact that he has a decision to make, that this decision must go through various stages, and that the general decision-making skills should be incorporated. Here, the seaman learns the stages and skills as they apply to his decision. This learning about stages and skills can be used for all his decision making, general as well as career.

The Life Career Game, as modified by Varenhorst (1970), may be adapted to Navy decisions as an activity for the seaman to examine his decision making in retrospect--that is, he identified (1) the Tiedeman substage, (2) the skills used in decision making, and (3) his "style of decision making" based on the Dinklage (1969) categories.

It would then be appropriate for the seaman to discuss actual decisions he has made, to identify the four stages, to talk about outcomes in terms of what he might have done if he had waited longer to make the decision and to see if he can begin to recognize the value of the vicarious activity before the actual decision in the low-cost, low-risk situation.

Problem-solving state: CLARIFICATION *substage*

> *In this stage, the person uses the stages and decision-making skills he has learned in interaction with another to learn about his style of decision making. However, if the decision-making process is individual and personal, how can another facilitate the sense of freedom and efficacy associated with the individual's satisfactory completion of the cycle of exploration, confusion, clarification, crystallization, and awareness-grounded action directed toward individually delineated and organized systems of "means whereby" and "end gains" (Tiedeman and O'Hara, 1963).*

> The answer may be found in the designing of facilitating relationships with the environment that are created around, for, and in the person to elicit and support his centering of himself in his self during his self-instruction (Perls, 1969). Perls contends that the essence of this centering process is developed awareness of the gestalt, i.e., the self-in-situation. He maintains that a personal need and a particular situation are two piers of the bridge in which the individual becomes the gestalt of himself in his situation. Needs are the individual's natural and individual processes as he perpetually seeks unity in his environment. Thus, need is an aroused condition within the person, demanding an association with his environment which will satisfy that need. As needs arise, the person becomes goal seeking; one aspect of the goal is satisfaction of the aroused need. Katz (1954) underscored needs in his proposed 5-point descriptive model of the decision-making process in which he pointed out that the decision-making process is motivated by the individual's needs and drives and by his being aware that these can be satisfied by his interactions with the environment.
>
> However, in our cubistic model, needs are expressed vicariously in the problem-forming state, incubate, and then are re-examined to see if the drive for that need is sustained. Therefore, the centering of the individual in his self-in-situation is a complete awareness of his need structure and a testing of that need structure with time, through the psychological states.

Each One Teach One. It is suggested that the understanding needed to develop an awareness of one's self as a person with both intentional needs and impulses rests in understanding the basic structure of teaching, that is, the necessity of helping in teaching but the impossibility of learning for another. Therefore, it is proposed that a Career Development program grounded in these assumptions must be designed so that one seaman teaches another about intentional decision making. While teaching another seaman the teaching seaman (under the supervision of someone like a counselor) is learning to understand the structure of his teaching--namely, his intent to help another seaman become intentional. In this way, the teaching seaman will grow in his understanding of the frustration he faces in being unable to accomplish his supposed end gain to any marked degree.

> In having each seaman teach another about intentional behavior the teaching seaman bears the difficulties of possible failure in his efforts to train another to be intentional. Contrast this situation with what usually occurs when decision making is taught. Normally, the bad decision is recognized as something the individual should avoid; everything is oriented toward the good decision--those that validate our society as it now stands. Success is reinforced and failure ignored. However, if seamen are taught to succeed in failure and to recognize that they will make bad as well as good decisions, then their decisions might improve as they seek to distinguish their intentional needs from intentional impulses through style recognition. A better decision may be made after centering on self, using our cubistic model incorporating the decision-making skills to gain a knowledge of decision-making style.

Use the Intentionality Behavioral Approach. Interactive decision making focusing on use of steps in process to recognize style could be translated into a functional framework by peer teaching. A guidance program could be structured to utilize seamen teaching each other in developing the intentional individual. The Intentionality Behavioral Approach developed by Ivey and Rollin (1971) may be adaptable as a means whereby the end gain of intentionality awareness might be achieved.

> The main objective of the Ivey-Rollin performance curriculums so far constructed is to develop the intentional individual, i.e., one who can respond freely and spontaneously to his surroundings and environment. The intentional individual supposedly has the tools to generate alternate world views enabling him to approach a problem from a different vantage point. He is able to understand and consider alternate perceptions of himself and others. The intentional individual constantly acts. This action is drawn from a wide variety of behavioral alternatives open to him. "In the early stage the individual has something with which to interact and in the late stage students can utilize constructs in their own fashion and eventually develop their own unique world view and teaching style" (p. 150).

The Ivey-Rollin approach is primarily a training approach for teachers. In adapting this approach to Career Development, the training aspect of this program must not be overlooked. To create intentional individuals by training methods may risk what Perls calls the bane of our civilization, i.e., the creation of persons "with character" but without "self." To avoid character ossification, intentions must develop in relation to a person's understanding of the basic structure of his needs, namely the relationship of his structuring of the environment to satisfy his principal need demands. However, he must use the method described to examine what at the moment he thinks are needs and what in the long run are only impulses. This distinction is important if we are to improve decision making. There must be a reciprocal awareness of needs and impulses as they relate to style of decision making, and the individual must be "doing with awareness" to make the distinction.

Style of Decision Making. Style of decision making is one of the critical points in our cubistic model of decision making. We define style as the strategy used in making decisions. For example, does the individual make a quick "impulsive" decision, an "intuitive" decision, or a "planned" decision, etc.? We then seek to have the seaman identify his own style of decision making by using the Dinklage "Inner-Reliant" (I-R) and "Other-Reliant" (O-R) strategies. In 1969, Dinklage defined "Inner-Reliant" deciders as those who take responsibility for their own decisions and the "Other Reliant" as those who transferred that responsibility to someone or something else. She found that approximately 42 percent of her high school students were "Inner-Reliant" deciders. Obviously, it is desirable to increase the number of "Inner Reliant" in the population generally and in the Navy population particularly. More specifically, each Dinklage strategy is as follows:

> Impulsive decider--one who takes the first alternative that is presented. "Decide now, think later."

Fatalistic decider--one who leaves the resolution of the decision up to the environment or fate. "What ever will be will be."

Compliant decider--one who goes along with the plans of someone else for him, rather than makes his own decisions. "If it's ok with you, it's ok with me."

Delaying decider--one who delays thought and action on his problem until later. "I'll think about that tomorrow."

Agonizing decider--one who spends much time and thought in gathering data and analyzing alternatives only to get lost amidst the data he has accumulated. The "I can't make up my mind" type.

Planning decider--one whose strategy is based on rational approach with some balance between the cognitive and emotional. "I am the captain of my fate: I am the master of my soul."

Intuitive decider--one who decides on what he feels but cannot verbalize. This is the "it feels right" type.

Paralytic decider--one who accepts the responsibility for his decision but is unable to do much toward approaching it. The "I know I should, but I just can't get with it" type.

These strategies are identified by the seaman as "each one teach us one" using the Ivey-Rollin approach oriented toward identification of decision-making style. The style is identified based on the actual choice made recycling through the substages of exploration, crystallization, choice and clarification (problem-solving state).

Remember that all the exercises involve use of a seaman's experience, not profiles of another's experience except in rare cases. This should not be threatening to the seaman as he is dealing with everyday decisions which do not involve exposing that which he has not already exposed by his decision. For example, decisions about what to do off duty, what to buy on shore leave to take home, and the like are what is called "low-risk and low-cost" decisions which allow the seaman to learn about decision making on a somewhat safe basis before he has to make decisions on a high-risk, high-cost basis. The emphasis, therefore, is oriented toward teaching the individual how to improve his decision making in the low-risk, low-cost area which generalizes to the high-risk, high-cost area. However, there are some decisions that, regardless of how good a decision maker the individual is, cannot be decided well without help. For example, in home buying, not very many people know to look beyond the "ginger bread" in a house--fancy fixtures, extras that cover up defects, etc. A seaman needs to have this kind of information presented to him so that, when he marries and decides he wants to own a home, he will have the knowledge necessary to make a decision that best benefits him. Otherwise all the decision training in the world will not equip him to make that "one-shot" decision. It is believed that in giving the seaman experience in improving his decision making on those things that present themselves often for improvement (low risk, low cost) and in giving him information about those "one-shot" decisions that he makes once or twice in his life (high risk, high cost). Futhermore, there are some decisions that strategy does not improve as much as good information does. This leads to the last psychological state, solution using.

Solution-Using State: ACCOMMODATION Stage

In this state there are no props; the individual is alone with his skills. However, an activity that would be appropriate in this phase is a group situation where seamen share what they have been experiencing, problems they have in "doing with awareness," the improvement they have made, and the excitement of discovery with themselves. It is important to allow seaman to share their accomplishments as well as their problems.

The decision making from the frame of reference of the person experiencing it has been presented. All our suggested activities have their origin in the experience of the person--looking at what he does now to improve what he will do in the future.

The experiential frame of reference from the Tiedeman paradigm of decision making has been discussed; first, its origins in educational and vocational identity, then augmented by O'Hara's work in vocational identity. The union of identity and decision making with Ellis' ideas on the comprehension of one's self-deciding was then enlarged upon. Incorporated was Miller's use of person-to-person interaction in centering one's decision making activity in self. Finally, these five major ideas were integrated into the Miller-Tiedeman cubistic model of decision making. All this underlay the experiential framework from which was suggested activities inherent in the teaching of our model.

Remember that the underlying assumption of this cubistic model is the same as that of Career Development--helping the person comprehend his learning capacities and processes so that they are vibrantly actualized from "breath to death." If comprehending decision-making development becomes the primary aim in Career Development, renewal will occur in the Navy. The Navy then will not just expand its ranks with seamen who will not mature after enlistment as can happen if care is not taken to integrate comprehension of decision-making development into its basic training and service concepts. To cultivate the comprehension of style in decision-making development from the experiential frame that has been presented and illustrated will result in centering the decision-making process in self. An all-volunteer Navy consisting of such self-motivating, self-initiating, and self-correcting seamen can be an effective force for world peace and development.

The several riotous and rebellious events of the past decade suggests what should have been obvious before their occurrence. Dissatisfaction does not go away; it goes elsewhere. When dissatisfaction is great, it explodes. The Navy largely enlists individuals in their late adolescence and/or young adulthood. A program of Career Development is essential to further personal and self development and responsibility. The program that has been outlined in the previous section will have the desired and needed effect if the Navy will in its wisdom just understand the considerable need for introduction of more discretionary options into the career development of its enlisted personnel and also raise the frequency with which enlarged options can be chosen. The self-directed self needs support of an environment in which actual individual discretion is frequently possible and in which accountability for individual responsibility is invariably expected and facilitated.

A potential scientific dividend inheres in this proposal in addition to the personal and social or service dividends already discussed. A framework within which self development can take place within progressive career development has been described. The described adjuvant framework is the needed framework. In this framework, the individual participates with the helper or scientist in the analysis and development of his self concept through the intentionality concepts of review, feedforward, and feedback. Science demands that this process ultimately pass to the scientists' hands for description and repeated objectification. The individual can participate in this process for awhile at its start as Tiedeman (1970) argues. The newly introduced concept is that of collaborative, not unilateral decision making about self concept. In the collaborative concept it is necessary to delineate the collaborative content and procedure as well as antecedents and consequents. Other papers offer a fair start toward definition of the needed collaborative content. This paper elaborates the needed collaborative procedure. What stands ahead as challenge is both more explicit definition of the desired end state and delineation of the developmental process in progressive hierarchical self development in association with comprehension of decision making development.

In 1969, when refunding of the Information System for Vocational Decisions was under consideration, Tiedeman and others proposed that the completed System would in effect be the laboratory in which developmental comprehension of the phenomenon of epigenesis in decision making development can be objectified and understood scientifically. Although that earlier proposal failed of support, it is considered that the proposal is the most valid one for study of the phenomenon under consideration here. Study requires a laboratory in which decisions can take place repeatedly, prior conceptualizations and expectations are available, review and reconceptualization can occur, and new goals and feedback procedures can be defined and used.

The Information System for Vocational Decisions was such a system. The Navy Personnel Research and Development Center could turn the procedure outlined in the previous section into a similar system without benefit or disadvantage of computer by introducing appropriate personally and Center kept records of repeated individual decision making. Such a program of research could have great service, societal, and scientific advantage.

FOOTNOTES

[1] A.L. Miller and D.V. Tiedeman, "Decision Making for the 70's: Cubing the Tiedeman Paradigm and Its Application in Career Education", (Focus on Guidance, 5, 1972, 1-15.)

[2] David Tiedeman, American Institutes for Research - July 1973. August 1973 - Professor of Education, Northern Illinois University.

[3] Anna Miller-Tiedeman, Counselor, Abbott Middle School - July 1973, August 1973 - Counselor, De Kalb (Illinois) High School.

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A THEORETICAL MODEL

Abraham K. Korman

The theoretical innovation that has marked the study of behavior in the world of work over the past ten or fifteen years has been and continue to remain great, even for the most casual onlooker. Theoretical ideas have been brought forth and suggested in many different areas and, what is even more significant, research has been generated that has enabled the researchers to learn much about the nature of work behavior and the personal, technical and social factors which influence it in all its variations.

It is clear, however, that if these theories are to be useful and are to serve adequately in their primary function of stimulating new thoughts, new research and new techniques of practice, they need to be looked at periodically and evaluated as to the evidence that has accumulated relating to them. Such periodic visits should tell us whether the ideas proposed, and the predictions which stem from them, are still viable or whether some new framework is called for. Eventually, all theories come up wanting and a new framework comes to the fore. Hence, a continuing responsibility of the theorist is to keep examining his own work and to initiate changes in his conceptulization as new data becomes available.

The goals of this paper are basically two in nature. First, a brief review will be made of an hypothesis of work behavior which was proposed by the author some time ago (Korman, 1970, 1971) and the research which was directly stimulated by this hypothesis subsequent to its publication. Following this, an extension of this model will be proposed in order to overcome a since recognized lack in the original proposal.

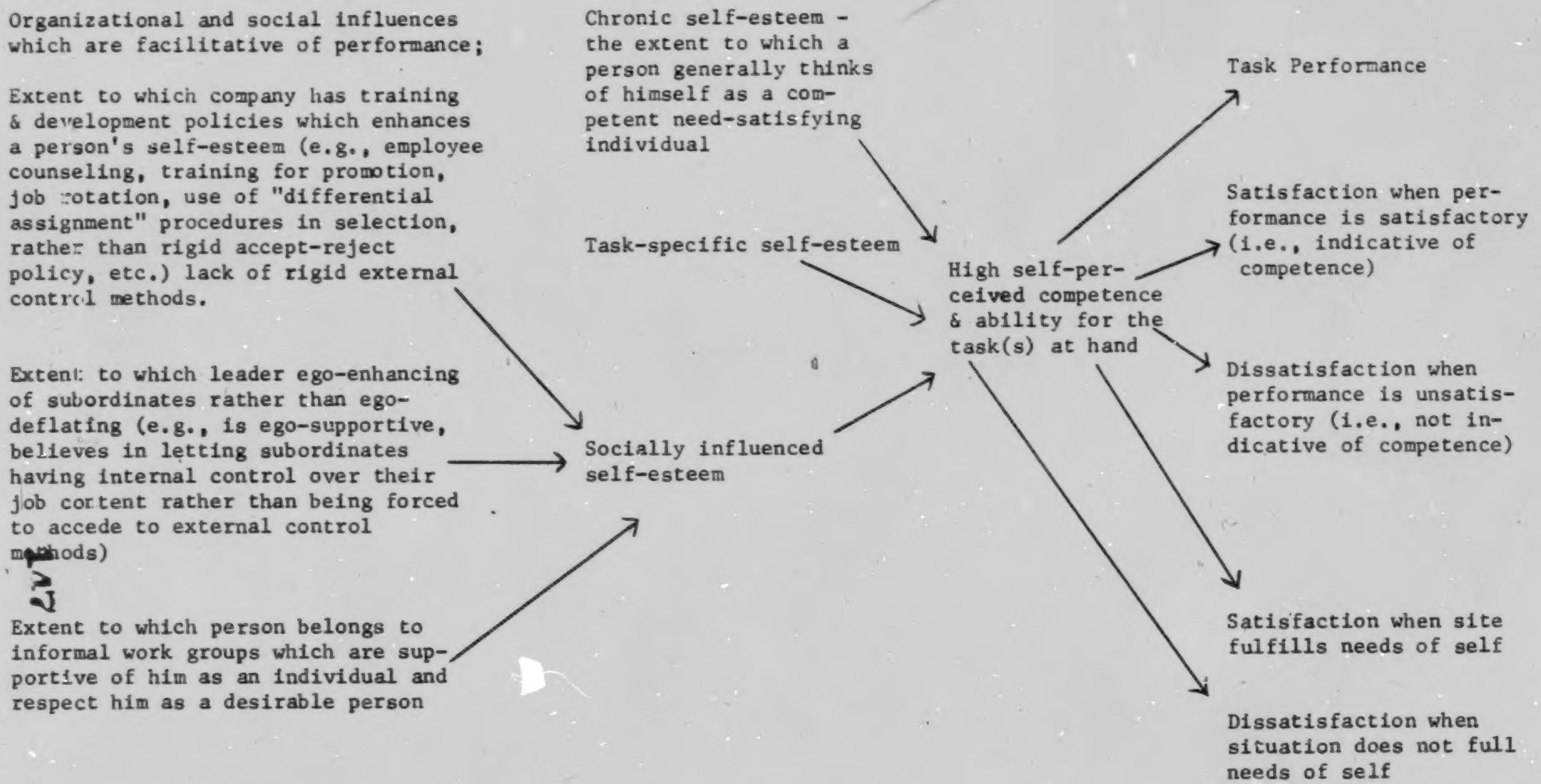
The Original Hypothesis and Some Consequent Evidence

The original hypothesis suggested was actually formulated in two complementary papers, the basic frameworks of which are reproduced here in model form as Figures 1 & 2. The rationale underlying these two figures was originally stated as follows:

> Thus, the following hypothesis is offered as to the nature of work behavior: All other things being equal, individuals will engage in and find satisfying those behavioral roles which will maximize their sense of cognitive balance or consistency.

This being the case, the following two derivations would be implied:

1. Individuals will be motivated to perform on a task or job in a manner which is consistent with the self-image with which



Organizational and social influences which are facilitative of performance;

Extent to which company has training & development policies which enhances a person's self-esteem (e.g., employee counseling, training for promotion, job rotation, use of "differential assignment" procedures in selection, rather than rigid accept-reject policy, etc.) lack of rigid external control methods.

Extent to which leader ego-enhancing of subordinates rather than ego-deflating (e.g., is ego-supportive, believes in letting subordinates having internal control over their job content rather than being forced to accede to external control methods)

Extent to which person belongs to informal work groups which are supportive of him as an individual and respect him as a desirable person

Chronic self-esteem - the extent to which a person generally thinks of himself as a competent need-satisfying individual

Task-specific self-esteem

Socially influenced self-esteem

High self-perceived competence & ability for the task(s) at hand

Task Performance

Satisfaction when performance is satisfactory (i.e., indicative of competence)

Dissatisfaction when performance is unsatisfactory (i.e., not indicative of competence)

Satisfaction when site fulfills needs of self

Dissatisfaction when situation does not full needs of self

Fig. 1. Outline of original consistency model of work behavior (Source: Korman, A. K. Toward an hypothesis of work behavior) Journal of Applied Psychology, 1970, 54, 31-41.

BASIC THEORETICAL ASSUMPTIONS

(1) Man is motivated to seek a stable world, hence will attempt to seek outcomes consistent with belief systems.
(2) Man's belief systems are a function of environmental experience and learning.

Consequences of Different Environments For Behavior

I

Environmental Characteristics		Consequent Belief Systems		Behavior
→ (i) High hierarchal control of behavior	→	(i) Man (both the self and others are undesirable since they must be controlled).	→	(i) Low achievement (ii) High aggression toward the self and others →
→ (ii) High programming and routinization of activities		(ii) There are universal rules and principles which one should use as a guide to behavior - these principles are universal, permanent and apply to everyone as guides to behavior	→	(iii) Hostility toward "change" and "variation" → (iv) Noncreative problem solving and behavior
→ (iii) High specialization and non-variability of activities	→			

II

Environmental Characteristics		
(i) Low hierarchal control of behavior (ii) Low programming and routinization of activities (iii) Low specialization and variability of activities	→	Opposing predictions to above

Fig. 2. Summary of model relating enviromental antecedents to motivational process. (Source: Korman, A. K. Organizational achievement, aggression and creativity: Some suggestions toward an integrated theory. Organizational Behavior and Human Performance, 1971, 6, 593-613.

> they approach the task or job situation. That is, to the extent that their self-concept concerning the job task situation requires effective performance in order to result in "consistent" cognitions, then, to that extent, they will be motivated to engage in effective performance.
>
> 2. Individuals will tend to choose and find most satisfying those job and task roles which are consistent with their self-cognitions. Thus, to the extent that an individual has a self-cognition of himself as a competent, need-satisfying individual, then, to that extent, he will choose and find most satisfying those situations which are in balance with these self-perceptions. (Korman, 1970)

Underlying this hypothesis were the following assumptions:

> For purposes of this hypothesis, the author assumes that one's self-esteem or self-evaluation is the extent to which he sees himself as a competent, need-satisfying individual. Differences in such self-evaluation may arise, for our purposes, in a number of ways. First a relatively chronic level of self-esteem may be conceived; that is, a relatively persistent personality trait that occurs relatively consistently across various situations. Second, one's self-perceived competence may be conceived as concerning a particular task or job at hand. This may arise as a result of differential learning experiences or the specific characteristics of the moment. Finally, one's self-esteem is also a function of the expectations which others have of us... to the extent that others (a) think that we are competent and need-satisfying and able, and (b) exhibit such thoughts by their behavior toward us, to the extent our self-perceived competence concerning the task at hand is increased and so is, predictably, task performance. The rationale for this is that such interpersonal evaluation provides a base of "reality" which we learn from our previous experience...

As support for this statement, a number of research studies conducted by the author were published. In addition, an effort was also made to show how these conceptualizations were consistent with the work of others.

Since the time of original statement of these proposals, a number of studies have appeared which were either directly stimulated by the hypothesis or are directly relevant to it. These studies have been reviewed and their results are summarized in Table I.

An examination of these findings shows a score card of eleven studies showing support for the hypothesis, three showing mixed support and one showing no support whatsoever. While one hesitates to draw firm conclusions about anything with which one has been personally identified, and certainly when concerned with only 15 studies,[1] it seems justified at this point to suggest that the original hypothesis still seems to be reasonably viable. Thus, even if one takes the problems of "Experimenter demand" in mind as a possible contaminant, this positive evaluation still appears warranted since:

a) the author had no knowledge of twelve of the studies until they were completed and became known to him;

b) the author served as doctoral dissertation advisor on one;

c) the author was personally involved in only two of the studies.

A Theoretical Extension

Given the findings, then, of Table I, and what also seems to be a relative lack of experimenter contamination, the overall logic of the hypothesis continues to remain useful. Yet, there is a problem with the framework and that is its prediction that the good get better and the poor get worse, with these effects increasing overtime. In other words, the model predicts that people, once they achieve success with their careers, will become increasingly successful, while those who have a failure experience will become increasingly unsuccessful. However, it is clear that there is something that is wrong with this conception. Not all successful people become increasingly successful and not all failures remain failures. Sometimes, people who were once achievement-oriented become "less so", and those who were once non-achieving become achievers. The question is "why"? Why these differentiated responses to success and failure? Can we ascertain the types of conditions or factors which lead to or determine these differing behaviors? One obvious value of being able to do this would be that we would then be able to deal with and, hopefully, control and influence both those factors leading to the decline of career effectiveness, once success has been attained, and those factors which lead a person to respond constructively to failure.

Since it is clear that the hypothesis, as originally developed, cannot account for these processes, some type of change is necessary. However, one consideration is that the extension should not, at this time, alter the logic of the original hypothesis and its basic predictions because of its (the hypothesis) continuing viability, as we have indicated above. In Figure 3 is presented such theoretical extension, one designed to account for these phenomena. Basically, what is proposed in Figure 3 is as follows:

a) In general, high self-esteem leads to career success and low self-esteem leads to career failure; (however, these predictions are not perfect and on occasion, high self-esteem people can fail and low self-esteem people can succeed; these statistically less likely outcomes are shown in Figure 3 as broken lines); a major outcome of success or failure is the engaging in of psychological attribution processes that involve cognitive and attitudinal re-evaluations of the conditions under which success or failure takes place. The contents of the attribution processes which take place are a function of the cultural and organizational values to which the person is exposed at the time, with these attributions hypothesized to occur as follows:

Condition I - b) When the cultural and/or organizational environment emphasizes hierarchal values, material rewards, and external control, and career success has occurred, the leaders who helped in the career success (e.g. parents, teachers, managers, etc.) and who dispensed rewards as a result of this success, tend to become valued. This positive evaluation of these leadership figures gradually becomes independent of the original reasons for the attitude and the rewards they originally dispensed and leads to the growth of attitudes and values favoring hierarchal systems of authority. These attitudes are then predicted to lead to career failure, primarily because of the low self-esteem such hierarchy-favoring attitudes lead to (although high self-esteem can as we have said, evidence career failure also. These statistically less-often occurring behaviors are shown in Figure 3 as broken lines.)

Condition II- c) When career failure occurs and outcomes sink below a level of satisfaction below that deemed appropriate for a low self-esteem person, and when the cultural environment (or organization), encourages non-hierarchal thinking, intrinsic work values and beliefs in internal control of behavior, it is predicted that there will be a rejection of the hierarchal attitudes that lead to low self-esteem and the increased likelihood of low outcomes. This rejection of hierarchy will lead to a higher valuation of self and the eventual engaging in of behaviors which would be appropriate to achieving career success.

Condition III-d) Finally, it is hypothesized that when the environmental conditions are opposite to those specified above, the opposite results occur, i.e. the successful become more so. Overall, then, the process being hypothesized is one where it is suggested that, sometimes, success breeds success, and sometimes, it breeds failure. Similarly, failure sometimes breeds failure, and, sometimes, success. In this way, it is proposed that we may be able to account for the general observation with which we started this discussion, i.e. the fact that, sometimes, successful people become unsuccessful and, sometimes, unsuccessful people become successful.

There are at least two major questions which arise in relation to the proposed framework. The first concerns the degree of specific evidence for the processes being suggested. Secondly, there is a problem in that we are proposing a contingency model here and, as we have said elsewhere (Korman, 1973a), contingency models are extremely difficult to test in empirical research.

For the first question, there are, as yet, no specific longitudinal tests of the model, as proposed, but several are in the planning stage and will be undertaken. One form of evidence that may be worth citing is that the model, as proposed, is consistent with a number of studies in the literature. These studies, which we have summarized in Table 2 were conducted within different frameworks than the one we have proposed here, but their findings are consistent with our general theme. However, despite this consistency, this type of evidence is only minimally satisfactory at best. Clearly, research studies stemming from and testing the longitudinal predictions of the model is necessary.

A second problem is that we are talking about a contingency model and these are very difficult to test (cf. Korman, 1973a) if contingency effects are predicted "a priori". The problem here is that such "a priori" tests assume knowledge of parameter values which make a test appropriate, a very difficult proposition. One way of overcoming this difficulty is to treat the contingency variable as an independent variable and then predict linear effects (such as the differential attributions we have hypothesized here) (Korman, 1973b). Other procedures are also possible, but the point is, difficult or not, if a contingency theory is necessary, then this is what needs to be developed, It is, then, up to our ingenuity to find a way of testing the theory, a challenge which we will attempt to meet in the research we will be designing in the future relative to the framework we have presented here.

Table I - Summary of Studies Relevent to Predictions from Korman Consistency Hypothesis of Work Behavior

Summary of Research	Investigation	Implications for Korman Hypothesis
1) College seniors actively seeking employment rated potential employers on same semantic differential instrument on which they had rated the self. Generally, support was found for the predictions that high self-esteem individuals would tend to implement their self-concept in choice of employers', those with low self-esteem would complement their self-concept, and those intermediate in self-esteem would do neither consistently.	Behling & Tolliver (1972)	Supports Hypothesis
2) The prediction was made and supported that persons high in self-esteem more often made second vocational choices that are consistent with their personality styles and persons low in self-esteem made second choices that are consistent about as often as choices that are inconsistent.	R. Leonard, Walsh & Osipow (1972)	Supports Hypothesis
3) The prediction was made and supported that there would be a positive correlation between measured self-esteem and congruence between description of self and description of chosen occupation.	Greenhaus (1971)	Supports Hypothesis
4) The prediction was made and experimentally supported that high self-esteem individuals would be made anxious by failure and the low self-esteem person would be made anxious by success.	Cohen (1971)	Supports Hypothesis

5)	The prediction was made and supported that success in task performance would predict satisfaction for high self-esteem individuals, but not for low. However, satisfaction did not differentially predict performance.	Siegel & Bowen (1971)	Mixed Support for Hypothesis
6)	The prediction was made but not supported in an experiment that success in task performance would predict satisfaction for high self-esteem individuals, but not for low.	Leonard S. & Weitz, J. (1971)	Does not support Hypothesis
7)	Individuals of high personal stability and integration were more likely to have made college major choices congruent with their personal characteristics than those with low levels of personal stability and integration.	Walsh & Lewis (1972)	Supports Hypothesis
8)	Experimentally manipulated task-specific self-esteem significally predicted task performance. Socially influenced self-esteem predicted task performance for high authoritations, but not for low. Chronic self-esteem did not predict performance in this experiment.	Greenhaus & Badin (1973)	Mixed support for Hypothesis
9)	The length of tenure in a high self-esteem inducing work environment (i.e. implying low hierachy, low routinization and low control by others) was found to be positively correlated with the degree to which these types of environment were positively correlated with achievement-orientated work attitudes and general work effectiveness.	Gavin Greenhous & Korman (1973)	Support for Hypothesis

10)	Individuals with chronic low self-esteem are made uncomfortable by success and avoid further success when (a) they are convinced by their low self-esteem and (b) they are made to feel personally responsible for their behavior. When these conditions are not true, the negative efforts of low self-esteem do not occur.	Maracek and Mattee (1972)	Mixed support for Hypothesis
11)	Individuals who expect failure in the future are more likely to reject success when it occurs than individuals who do not expect failure in the future.	Mattee (1971)	Supports Hypothesis
12)	Nations who were classified as high in achievement by McClelland (1961) were classified as low in aggression by Fieraband & Fieraband (1970) and Nations classified as low in achievement were classified as high in aggression.	Korman (1973c)	Supports Hypothesis
13)	Performance predicted satisfaction for high self-esteem but not for those with low self-esteem. Satisfaction predicted performance for low self-esteem but not for high.	Badin & Greenhaus (1973)	Supports Hypothesis
14)	Congruence between self-perception and perception of chosen occupation was greater for those with high self-esteem than for those with low self-esteem.	Healey (1973)	Supports Hypothesis
15)	High self-esteem interviewers are more favorably impressed with applicants with similar attitudes than with dissimilar applicants. For low self-esteem interviewers the relationship is reversed such that dissimilar applicants are more favorably evaluated than those with similar attitudes.	Leonard (1973)	Support Hypothesis

Table II - Summary of Evidence Relating to Proposal Model

1)	Low Self-esteem Ss who deny a social manipulation aimed at inducing low self-esteem do better at a later task than those low self-esteem Ss who did not protest the manipulation.	Pepitone, Faucheaux, Moscovici, Cesa Bianchi, Magistretti, and Iacono (1969)
2)	Low self-esteem boys who were held in high esteem by their peers and teachers had a greater achievement and self-improvement motivation than those low self-esteem boys who did not have high ratings from their peers and teachers.	Coopersmith (1967)
3)	Individuals who believe in Internal (personal) Control of Behavior expend more effort on similar tasks subsequent to failure than do those who believe in External Control.	Weiss and Sherman (1973)
4)	Individuals from backgrounds encouraging belief in control over ones life react more constructively to stress situations than do those coming from backgrounds encouraging powerlessness.	Tiffany & Tiffany (1973)
5)	Individuals who have performed tasks for money are less likely to perform tasks in the future when money is withdrawn than those who have not performed tasks for money in the past.	Deci (1972)
6)	The more hierarchal a society (in terms of economic inequality), the more members of that society will endorse approaches to leadership that involve mistrust of individuals and the need to manipulate them in a political manner.	Bass and Franke (1972)

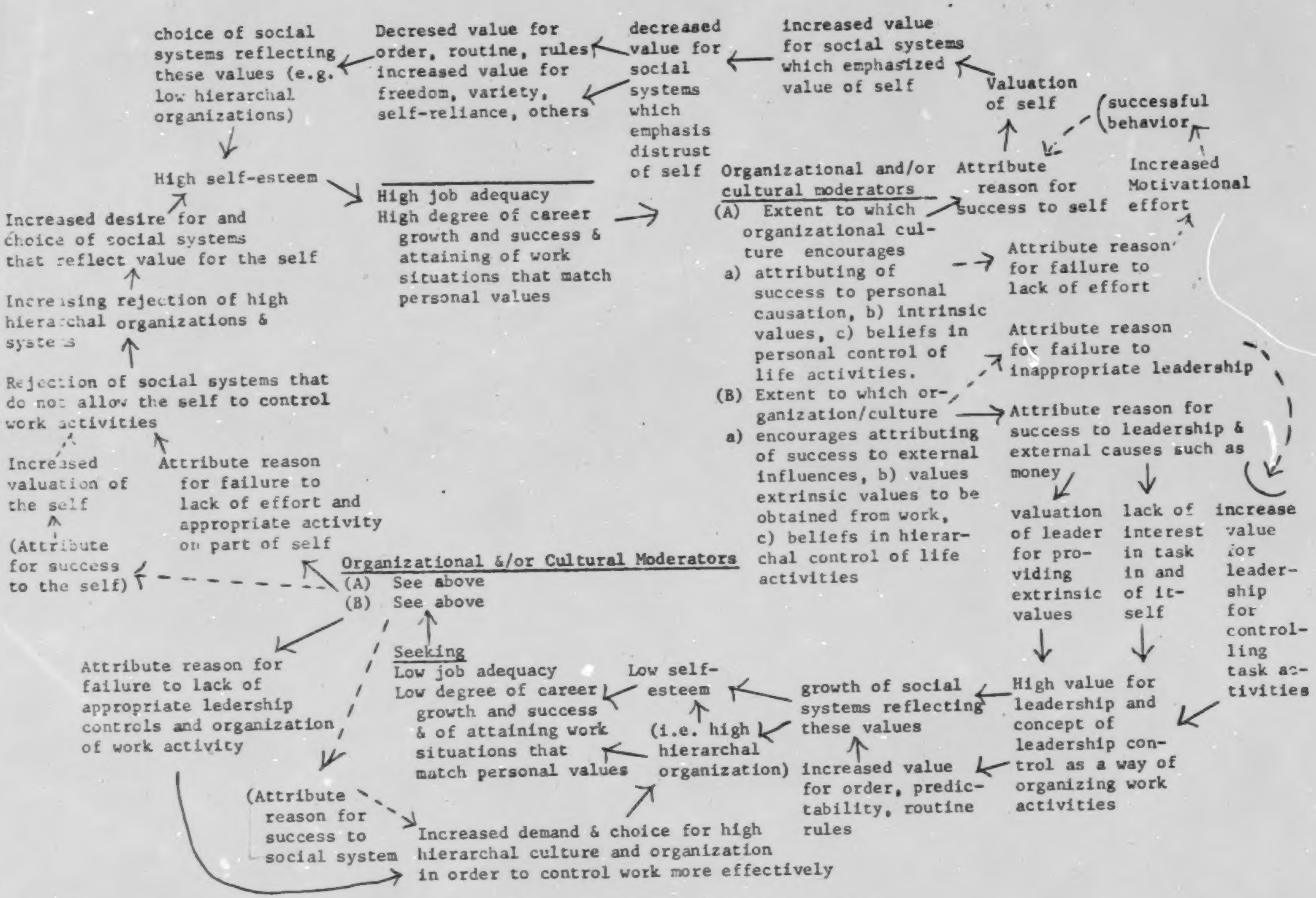

choice of social systems reflecting these values (e.g. low hierarchal organizations)
Decresed value for order, routine, rules; increased value for freedom, variety, self-reliance, others
decreased value for social systems which emphasis distrust of self
increased value for social systems which emphasized value of self
Valuation of self
(successful behavior
High self-esteem
High job adequacy
High degree of career growth and success & attaining of work situations that match personal values
Organizational and/or cultural moderators
(A) Extent to which organizational culture encourages
a) attributing of success to personal causation, b) intrinsic values, c) beliefs in personal control of life activities.
(B) Extent to which organization/culture
a) encourages attributing of success to external influences, b) values extrinsic values to be obtained from work, c) beliefs in hierarchal control of life activities
Attribute reason for success to self
Increased Motivational effort
Attribute reason for failure to lack of effort
Attribute reason for failure to inappropriate leadership
Attribute reason for success to leadership & external causes such as money
valuation of leader for providing extrinsic values
lack of interest in task in and of itself
increase value for leadership for controlling task activities
High value for leadership and concept of leadership control as a way of organizing work activities
Increased desire for and choice of social systems that reflect value for the self
Increasing rejection of high hierarchal organizations & systems
Rejection of social systems that do not allow the self to control work activities
Increased valuation of the self
Attribute reason for failure to lack of effort and appropriate activity on part of self
(Attribute for success to the self)
Organizational &/or Cultural Moderators
(A) See above
(B) See above
Seeking
Low job adequacy
Low degree of career growth and success & of attaining work situations that match personal values
Low self-esteem
(i.e. high hierarchal organization)
growth of social systems reflecting these values
increased value for order, predictability, routine rules
Attribute reason for failure to lack of appropriate ledership controls and organization of work activity
(Attribute reason for success to social system
Increased demand & choice for high hierarchal culture and organization in order to control work more effectively

Figure 3 - Extended Theoretical Model

Table II - Summary of Evidence Relating to Proposal Model

1)	Low Self-esteem Ss who deny a social manipulation aimed at inducing low self-esteem do better at a later task than those low self-esteem Ss who did not protest the manipulation.	Pepitone, Faucheaux, Moscovici, Cesa Bianchi, Magistretti, and Iacono (1969)
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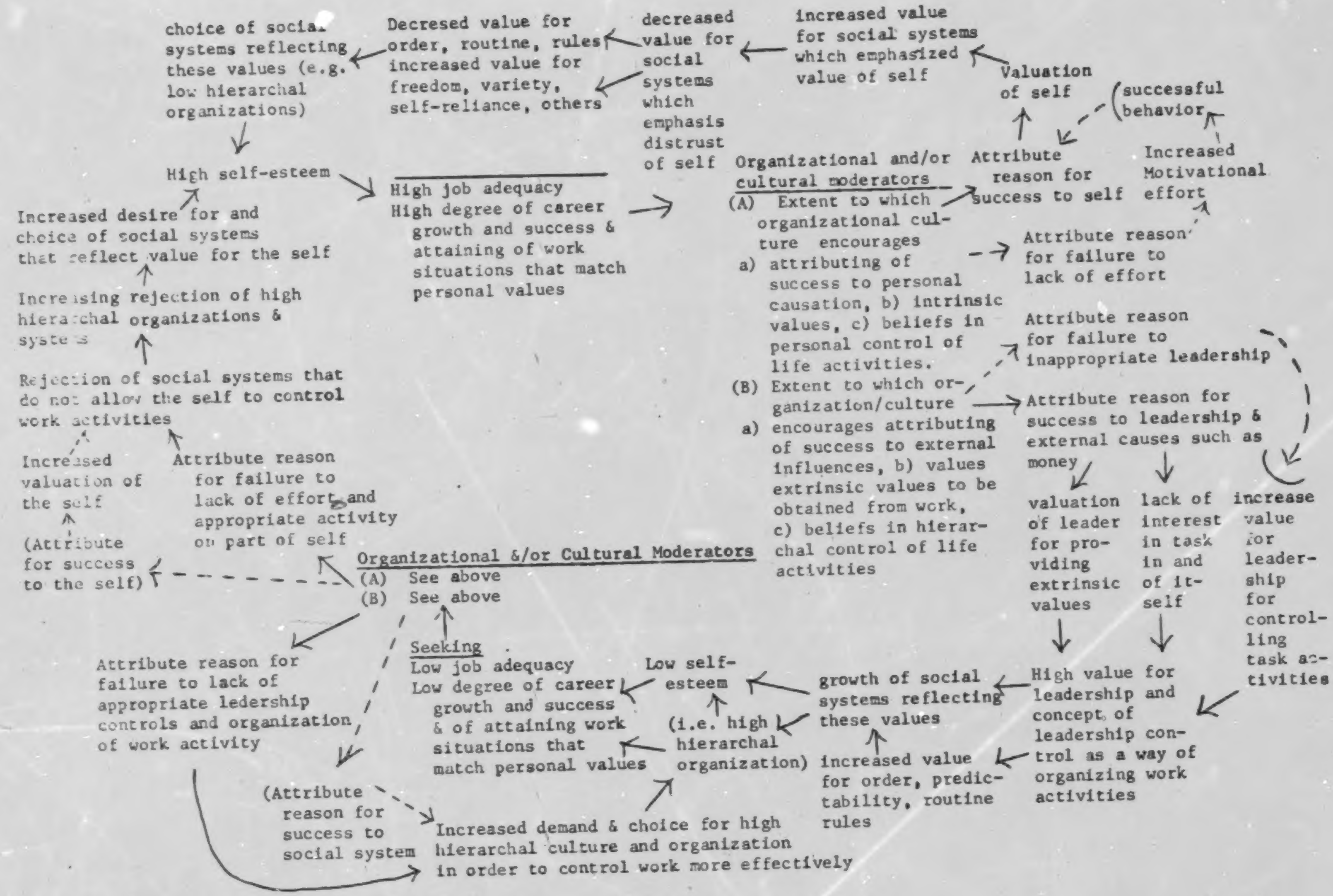
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Low self-esteem
(i.e. high hierarchal organization)
Organizational &/or Cultural Moderators
(A) See above
(B) See above
Seeking
Low job adequacy
Low degree of career growth and success & of attaining work situations that match personal values
Attribute reason for failure to lack of appropriate ledership controls and organization of work activity
(Attribute reason for success to social system
Increased demand & choice for high hierarchal culture and organization in order to control work more effectively

Figure 3 - Extended Theoretical Model

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PERSONAL VALUE SYSTEMS OF MANAGERS AND ADMINISTRATORS

George W. England

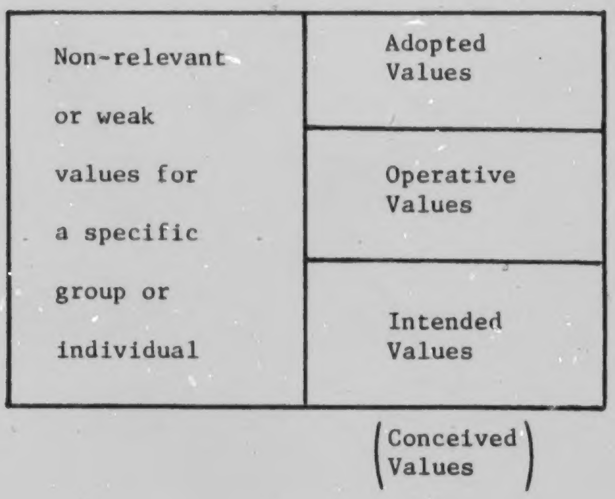
During the past six years, several of the researchers at the Industrial Relations Center have developed an approach to the study of personal value systems of managers and administrators.[1] To date the following values have been assessed: (a) 3,000 managers from the U.S.A., Japan, Korea, India and Australia; (b) 500 U.S. college students; (c) 200 U.S. educational administrators; (d) 300 U.S. Naval officers; and (e) 136 U.S. labor leaders. While there has been a number of publications of journal articles, research monographs and technical reports on the approach and findings, it seems appropriate to present a brief summary of the approach, results and possible implications of this work. Undoubtedly there are opinions biased toward overestimating the importance of the work but a sincere effort to be realistic has been made. What was really found and what does it all mean?

Rationale for the Studies

A framework was developed to delineate the relationship of values to behavior for managers and was subsequently utilized in the development of a measurement approach to personal value systems that (1) was responsive to relevant theoretical and definitional notions of contemporary value theory, (2) was designed in light of the characteristics of the group being studied (managers), and (3) was clearly cognizant of the primary importance of the behavioral relevance and significance of values.

Several major classes of overlapping values are recognized in the framework. All possible values which might be held by an individual or by a specific group constitute the total value space and are known as potential values. The potential values are made up of two classes of values: non-relevant or weak values for a specific group or individual (those which would have little or no impact on behavior) and conceived values (those which are likely to be translated from the intentional state into behavior). Conceived values are made up of operative values (those which have a relatively high probability of being translated from the intentional state into actual behavior, intended values (those which are viewed as important but may have only a moderate probability of being translated from the intentional state into behavior because of situational factors), and adopted values (those which are less a part of the personality structure of the individual and affect behavior largely because of situational factors).

Potential Values


Non-relevant or weak values for a specific group or individual
Adopted Values
Operative Values
Intended Values
Conceived Values

The development of the Personal Values Questionnaire (PVQ) was based on the rationale that the meanings attached by an individual to a carefully specified set of concepts will provide a useful description of his personal value system, which may in turn be related to his behavior in systematic ways. This attempt to describe an individual's values through the use of a carefully specified set of concepts was influenced by the work of Charles Osgood and his associates and represents an adaptation of their methodology.

In order to specify a set of concepts relevant to the personal value systems of managers, a pool of 200 concepts was selected from literature dealing with organizations and with individual and group behavior. In addition, ideological and philosophical concepts were included to represent major belief systems. A panel of expert judges reduced this pool to a set of 96 concepts, which was further reduced to 66 concepts based on pilot studies. To provide a framework within which respondents could conveniently evaluate each concept, the concepts were categorized into five classes: goals of business organizations, personal goals of individuals, groups of people and institutions, ideas associated with people, and ideas about general topics.

In the PVQ for managers, four scales are used to represent two modes of valuation. Since the general value of an object or idea to an individual is thought to be largely a function of its degree of importance to him, the primary or power mode of valuation utilized is the importance scale, which consists of three points--high, average, and low. Because of the emphasis on the behavioral effect of values, it was deemed necessary to make operational the theoretical distinction between the intentionality of values and their translation into behavior (operative values from among conceived values). To the extent that it is possible to determine a consistent rationale as to why an individual or a specific group thinks certain concepts are important or unimportant, one has a reasonable basis for distinguishing operative from among conceived values. In this process, three secondary modes of valuation were developed from the literature. The *pragmatic* mode of valuation suggests that an individual has an evaluative framework that is primarily guided by success-failure considerations; will a certain course of action work or not, how successful or unsuccessful is it apt to be. The pragmatic mode of valuation runs throughout much of the literature dealing with managers and finds support in various analyses of the Allport-Vernon *Study of Values* which suggest a major dimension of values as being "pragmatic and utilitarian" or the finding of a major value factor being "idealism vs. practicality".

The *ethical-moral* mode of valuation implies an evaluative framework consisting of ethical considerations influencing behavior toward actions and decisions which are judged to be "right" and away from those judged to be "wrong". The existence of a moralistic-ethical orientation is at the very heart of most religious belief systems and is supported by analyses of the *Study of Values* which find value dimensions or factors such as "social and altruistic" and "idealism".

The *affect or feeling* mode of valuation suggests an evaluative framework which is guided by hedonism; one behaves in ways that increase pleasure and decrease pain. The affective component of values has an extensive philosophical and psychological background and seemed important to include as an orientation in the present studies.

In the PVQ, the pragmatic mode of valuation is represented by a "successful" scale; the ethical-moral mode of valuation is obtained through a "right" scale; and the affect or feeling mode of valuation is measured through use of a "pleasant" scale.

A combination of primary and secondary modes of valuation was thought to be a better behavioral predictor than would either mode alone. For example, if Manager A is generally pragmatically oriented (i.e., concepts which were important to him were also seen as being successful as opposed to right or pleasant), his behavior would be predicted best by viewing it as a joint function of those concepts he thought were *important* and *successful*. In a more general sense, what is being suggested is that an individual's behavior (insofar as it is influenced by his personal values) is best explained by utilizing both those things he considers important and his personal primary orientation. Symbolically, one could say:

$$B_V \longrightarrow f(I \cap PO)_C$$

This expression would be read: the behavior of an individual, insofar as behavior is a function of values, is best indicated by the joint function of those concepts he considers important and which fit his primary orientation. For a pragmatically oriented individual, behavior is best indicated by those concepts considered important and successful; for a morally-ethically oriented individual, behavior is best predicted by those concepts considered important and right; while for an affect oriented individual, behavior is best predicted by those concepts considered important and pleasant.

This, then, is the general rationale for the studies reported. The starting point is the individual manager in a work organization; the interest is in his values and what is told about his work behavior and outcomes of this behavior. This is not a study of organizations, industries, nations or cultures although each manager in our studies certainly can be placed within these broader frames of reference. It is apparent, however, that the individual results must be aggregated to focus on many questions of interest.

Summary of Study Results

1. There are large individual differences in personal values within every group studied. Among managers in each country, for example, some have a pragmatic orientation (they view ideas and concepts in terms of whether or not they work or are successful), some have an ethical-moral orientation (they view ideas in terms of being right or wrong), while some have an affect or feeling orientation (they view ideas in terms of whether or not they are pleasant). Some managers have a very small set of values while others have a large set and seem to be influenced by many strongly held values. The important values of some managers include concepts which are almost solely related to their organizational life while other managers include a wide range of personal and philosophical concepts among their important values. Some managers have what might be termed individualistic values as opposed to group-oriented values. Some managers are highly achievement-oriented as opposed to others who value status and position more highly. Finally, it is clear that some managers have a personal value system that might be characterized as "hard". Their important values include concepts such as Ambition, Obedience, Aggressiveness, Achievement, Success, Competition, Risk and Force. Other managers have value systems that are often characterized as "soft" and include such concepts as Loyalty, Trust, Cooperation, Compassion, Tolerance, Employee Welfare, Social Welfare and Religion. Personal value systems, then, are like most other human characteristics; individuals differ greatly with respect to them.

2. Personal value systems of managers are relatively stable and do not change rapidly. In 1966, the personal value systems of a national sample of U. S. managers was measured. In 1972, Professors Edward Lusk and Bruce Oliver of the University of Pennsylvania Wharton School repeated the earlier study on a comparable national sample of U. S. managers. They reasoned that the widespread airing of environmental and social issues (e.g., pollution, the Vietnam War, life style changes, changing expectation of the labor force, and minority and disadvantaged group employment problems) between 1966 and 1972 would be accompanied by changes in the value systems of managers. The differences between the value systems of the 1966 sample and the 1972 sample of managers were very small. Over all 66 concepts in the value instrument, the average difference in value importance was only 3.3 percentage points between the two time periods. A difference of ten per cent or greater between the two samples was found on only four of 66 concepts. The 1972 sample placed greater value on the concepts (dignity, trust and change) and lower value on the concept (my boss) as compared to

the 1966 sample. These results show quite clearly that the personal value systems of 1972 managers are very similar to those of 1966 managers. Personal value systems of managerial groups do not change rapidly even during periods of environmental and social flux. A probable explanation for this stability would involve the nature of the selection and developmental process managers go through, the requirements and constraints that the job of managing places upon managers and the fact that personal values are a relatively stable human characteristic.

3. Personal value systems of managers are related to and/or influence the way managers behave on the job. While several of the studies show this to be the case, the clearest evidence emerges in the study of Indian managers. Here the personal values of each manager was assessed and his behavior was measured on five job incidents, each representing a typical problem which a manager might encounter in the performance of his job. Prior to analyzing the data, 25 predictions were made about how managers with certain values would be expected to behave. Examples of these predictions are: (a) managers who have profit maximization as an important goal will be less willing to spend money on cafeteria and rest room facility improvements than will managers who do not have profit maximization as an important value, (b) managers for whom compassion is an important value would be less willing to obtain research and development funds by depriving employees of part of a potential wage increase than would managers for whom compassion is not an important value, and (c) managers for whom cooperation is an important value would promote individual B to be their assistant more than would managers for whom cooperation is not an important value given the following choices--

> Individual A is a very creative man who has been constantly making suggestions for improvement in office procedures. Although all his ideas are not practical ones, you have in the past, adopted some of his suggestions. A is sincere and hard working, and he can be very helpful to others if he is asked for his help. He is, however, not a very popular man in the department, because other employees do not like procedural changes and extra pressures which they think are unnecessary at times.
>
> Individual B, equally efficient as A, is not a man of ideas. He, on the other hand, is a very congenial and well liked person. He goes out of the way to help others whenever they have problems and is definitely contributing to the good morale of your department. He enjoys the reputation of a kind man.

Across all five incidents, 19 out of 25 predictions are supported by the data. These results offer strong support for the contention that values are related to behavior in meaningful ways for managers. The fact that the relationships exist within a sample of managers from many different organizations all across India and from managers with varied organizational and personal backgrounds is clear evidence of the role of personal values in influencing problem solving and decision making behavior. Personal values are certainly important in understanding and predicting the behavior of managers.

4. Personal value systems of managers are related to their career success as managers. Career success or personal success is defined in terms of managerial pay relative to the manager's age in the studies of American, Japanese, Indian and Australian managers. It was judged that the heterogeneous nature of the samples dictated that success be measured in terms of objective data that were relatively easy to collect. Relative salary level for one's age group provided such a measure which was sufficiently accurate. Then a value profile key or pattern that was related to success in each of the four countries was developed and cross-validated. The value patterns that were related to success were similar in the four countries and correlated with success as follows: U.S.A. (.32), Australia (.47), India (.35), and Japan (.26). These correlations are of similar magnitude to the validity coefficients generally reported for predicting manager success by other types of predictors. These results were viewed as solid evidence that value patterns and success are meaningfully related in a similar fashion across the four countries.

Viewing the value-success relationships of American managers provides the following picture. Successful managers favor pragmatic, dynamic, achievement oriented values while less successful managers prefer more static and passive values, the latter forming a framework descriptive of organizational stasis rather than organizational and environmental flux. More successful managers favor an achievement orientation and prefer an active role in interaction with other individuals useful in achieving the managers' organizational goals. They value a dynamic environment and are willing to take risks to achieve organizationally valued goals. Relatively less successful managers have values associated with a static, protected environment in which they take relatively passive roles and often enjoy extended seniority in their organizational positions.

Since the value systems of American managers seem relatively stable over time and since values are related to success, the possibility of using values as a selection or promotion device in attempting to pick people who will turn out to be successful has been explored. The following expectancy table show the chances out of 100 of a person with a given value score being among the top half of managers in terms of success.

Value Score		*Chances in 100 of Being Among the Top Half of Managers in Terms of Success
Very High	(Top 20%)	75
High	(Next 25%)	62
Medium	(Next 35%)	56
Low	(Next 15%)	41
Very Low	(Bottom 5%)	25

*Total sample size is 875 managers

Value patterns are predictive of success and could be used in selection and placement decisions. Personal values are not recommended in selection because the full consequences of an individual organization having managers with like value profiles are unknown. Persuasive arguments can be made that organizational vitality and adaptation to changing social and technological conditions may come about in large part because of the value mix in an organization. There may well be some optimum range of value differences within an organization; but what that optimal range is for any given organization is unknown.

5. There are differences in personal values of managers working in different organizational contexts. One example of the impact of type of organization upon values is shown when compared with the personal values of U.S. managers with U.S. labor leaders. In general, union leaders have a moralistic orientation while managers are pragmatic. Owners and stockholders represent important values (likely to influence behavior) for managers and weak values (unlikely to influence behavior) for union leaders. Similarly, blue-collar workers and laborers represent important values for union leaders and weak values for managers. As regards organizational goals, employee welfare and social welfare are important values for union leaders and weak values for managers. Just the opposite is true for high productivity, organizational stability, organizational growth, organizational efficiency, and industry leadership. Finally, ambition, ability and skill represent important values for managers while trust, loyalty and honor are much less important. For union leaders, just the reverse is found. These differences help explain why the two groups approach various issues from conflicting directions. Perhaps it is only recognition of mutual dependence as a fundamental aspect of modern industrial relations that allows cooperation between the groups to result even though it may be, as some writers have suggested, "antagonistic" in nature.

An example where organizational setting does not make a difference is found when one compares Indian managers from the private sector with those from the public sector. Despite the basic differences in setting, there is great similarity between the value profiles of public and private sector managers. The profiles of the two groups correlate .98 and are almost identical. Although this high degree of similarity is surprising, it may result in part because the private sector is a primary source of managerial talent for the public sector and because of the social pressure for public sector firms to view private sector companies as ideals in some respects so as to become viable economic units. These forces may result in public sector managers having values and concerns which are typical of private sector managers.

A final example of the impact of organizational variables upon value systems is found when one looks at value differences between managers employed in firms of different size. In an analysis of American, Japanese and Korean managers, large firms are defined as those with 5,000 or more employees, medium size firms as those with 500-4, 999 employees and small firms as those with 1-499 employees. In all three countries, there was a general trend of organizational goals being a more important part of managers'value systems in large firms, less so in medium size firms and least important in small firms. This was the case for the goals, high productivity, profit maximization, organizational growth, organizational efficiency, and industry leadership. There was no relationship between size and the importance of the goals, organizational stability and social welfare. The patterns in each of the three countries were similar and suggest that the effects of environmental uncertainty, organizational complexity and conflicting organizational goals in large organizations may explain these findings. One might logically assume that as organizations increase in size, managers are confronted with more difficult, more complex, more ambiguous and more challenging decisions. Communication and interpersonal relationships also become more complex and difficult, and goal clashes become inevitable. The consequences of these management and coordination problems undoubtedly are more challenging in large firms than in small firms and, therefore, influence top managers of large firms to be more aware of organizational goals and to ferret out deviations and to establish systems of controls and incentives which ensure internal conformity with the firm's goals. Managers of small firms emphasized the goal of employee welfare more than did managers of larger firms; this finding is in accordance with observations of many writers about the relative advantages of small firms.

Personal value systems do differ in different organizational contexts in ways that are generally understandable. It is not known, however, whether these differences are largely a function of the type of people who go into certain organizational contexts and/or to what extend people's value systems adapt to the organizational context in which they find themselves.

6. There are both differences and similarities in the value systems of managers in the different countries studied. One indication of similarity is seen when the correlation of value patterns between each pair of countries is observed.

	Japan	Korea	India	Australia	U.S.A.
Japan		.92	.67	.64	.76
Korea			.71	.64	.72
India				.85	.79
Australia					.95

The correlations show that the value patterns of all the country pairs are significantly related. The U.S. and Australia are most similar, Japan and Korea are almost as similar, and India and Australia are quite similar. Korea and Australia, and Japan and Australia are least similar while Japan and India are only slightly more similar. It should be remembered that these are overall country profiles that are being compared and they do not show the individual variation that exists within each country. These data suggest that cultural and social factors as opposed to level of technological development and degree of industrialization are most important in explaining value differences and similarities.

Amidst all of this similarity, there are differences in value patterns between the five countries. A thumbnail sketch of several observations about the values of managers in each country will highlight some of these differences

U.S.A. Managers

-Large element of pragmatism.

-Low importance of political and social values.

-Emphasize traditional organizational goals such as profit maximization, organizational efficiency and high productivity.

Japanese Managers

-Very high element of pragmatism.

-Value magnitude very highly (size and growth).

-Place low value on conflict and its open expression.

-Motivation for work seems more a product of forces external to the organization than internal to the organization.

Korean Managers

-Large element of pragmatism

-Place low value on most employee groups as significant reference groups.

-Low importance of political and social values.

-Low value placed on organizational goals.

Indian Managers

-High degree of moralistic orientation.

-High relevance placed on political values.

-Value stable organizations with minimal or steady change.

-Value personalistic goals and status orientation.

-Value a blend of organizational compliance and organizational competence.

Indian Managers (Continued)

- Place low value on most employee groups.

-Major regional differences in values of managers.

Australian Managers

-High degree of moralistic orientation.

-High emphasis on social and political values.

-Place low value on growth and profit maximization.

-Place low value on such concept as achievement, success, competition and risk.

-Major regional differences in values of managers.

7. The work then leads to the conclusion that the personal values of managers are both measurable and important to measure. Values are related to such practical and important concerns as decision making, managerial success and organizational context differences. While having learned a great deal about values and their role in organizational life, there is still much more to know. It is not known, for example, how value systems develop and how they are changed by organizational experiences; what are acceptable or optimal levels of value disparity within organizations or sub-organizations to aid in the achievement of organizational success; what are the effects upon individuals of providing them with valid information about their own value systems; what values are most compatible with movement toward a post industrial era or multi-national corporate life, and finally, how value measurement might aid in the strain toward consistency that all must make between what we believe and value and how we behave.

FOOTNOTES

[1] Those directly involved in these studies have been N.C. Agarwal, O.P. Dhingra, R.E. Henderson, T.J. Keaveny, L.D. Kim, R. Koike, R. Lee, K.A., Olsen, D.W. Oxnam, N.R. Rydel, R.E. Trerise and M.L. Weber.

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CAREER MOTIVATION IN THE NAVY

Albert S. Glickman, Ph.D

INTRODUCTION

The Prospects for Change

About a year and a-half ago AIR proposed its current Career Motivation project under the new ONR Manpower Research and Development Program. The proposal recorded my impression that many of the studies undertaken during the past 20 years used much the same methods to obtain much of the same results. I also observed how little real impact these results had had upon policy, and that if we continued to make the same assumptions and set the same inflexible limits on change, the final report could be written at the beginning of the project without the nuisance and delay of collecting and analyzing data.

But there were signs that Navy officialdom recognized that the end of the draft signalled the need for a more probing look; that "givens" long unquestioned might not be applicable today; that the conventional ways of coping with these problems might no longer suffice; and that there was need for an integrated conceptual framework--as contrasted with the discontinuous, fragmented, make-do improvisations that have often diminished the usefulness of personnel research. The storm cloud hanging over the manpower domain had a silver lining of research prospects. The threat of impending disaster might actually open up real possibilities for inducing change.

Buoyed by that hope, we once again set forth upon the turbulent seas of career motivation research in the first part of 1972. This provides most of the material for this essay on the state-of-the-art of career motivation in the Navy.

Problem and Purpose

The purpose of the Navy career motivation research project is threefold:

(1) To develop knowledge of the influences affecting decisions concerning Naval service at certain key points in the life of a young man who is a potential recruit or an active member of the Navy;
(2) To examine current assumptions, policies, and practices for the attraction, development, and retention of personnel; and
(3) Most crucially, to ultimately develop and evaluate new administrative approaches to more effectively cope with the problems of assuring a well-qualified and motivated supply of manpower in the Navy.

The emphasis given to this last point fits the impression that perhaps the Navy's most critical handicap in matters affecting career motivation is the lack of [illegible] integrated system that consistently obtains prompt and sensitive feedback indicating how well innovations meet expectation, and that provides alerting signals before problems reach a critical level. What had been criticized as lack of organizational flexibility may have represented simply a lack of signals for action in many cases.

Problems may not surface for the key decision-maker until they have assumed gross proportions. So, there may be considerable time between a problem's genesis and the initiation of corrective measures. Then, the magnitude of the remedy required becomes greater and its impact is blunted --the opportunity to employ simpler and subtler means is lost. Hence, a major requirement is to develop better techniques for obtaining sensitive feedback, and to increase the odds that such knowledge will be put to timely and effective use.

Perhaps in the Navy there has been too much attention paid to how to influence and change *people* and not enough attention has been given to how the *organization* can be changed so that it may better prepare to assimilate changed people, and/or to how the organization could be changed to effect a more effective person-organization symbiosis.

Likewise, there is need to give more attention to the design of appeals, incentives, and organizational changes with specific and limited target populations and problem situation in mind. Too often, "mountain-moving" approaches are undertaken, aimed at the whole Navy. Because they try to include everyone under all conceivable circumstances, their overall impact is diluted, and it is difficult to figure out what are the influences that have positive or that have negative effects.

For these reasons, the Navy's action research objectives are being best served in most instances by conducting a series of studies that fall into what are called a "ripple pattern"--that is a sequence of relatively small scale replications with modification, rather than global studies designed to be representative of large areas of organization and populations all at once.

So, for example, to test the relative appeal of a variety of new incentives and organizational changes potentially affecting re-enlistment behavior, the research started out where an acknowledged problem situation already existed, so that findings that appeared to be useful might have a point of fairly direct application. Men are being used in three different kinds of shortage ratings--Electronic Technicians, Hull Technicians, and Enginemen, located chronologically at four different points in the first enlistment. The interest was to see which innovations and combinations of innovations appeal to which ratings and length-of-service groups; and which are specific and which are general. Later the limits of generality will be probed by replicating with different ratings, using some of the innovations that look most promising, adding some other innovations, and making use of longitudinal instead of cross-sectional data.

Obviously, it would be virtually impossible to catalog every possible individual-centered and organization-centered change and evaluate its impact. To most effectively exploit the potential for administrative innovation, a conceptual framework is needed to guide the exploration and evaluation of potential changes--to help identify the problems that are most unusual; to sharpen awareness of the interactions among variables and the practical ramifications associated with given manipulations; to indicate where the system might be most susceptible to change and where change induction could have maximum effect; to offer clues to hypothetical constraints subject to experimentation; to provide bases for designing simulations, and so on. That is to say, we need a model of Navy career development centering on the motivation of the individuals involved. Since we could not find one, we developed our own.

Military and Civilian Perspectives

Let us stop for a moment to make a retrospective comparison of military and civilian life over the span of a generation.

Of the most immediate notice is the absence of the military draft, which, with the exception of a relatively brief pre-Korea gap, has been with us since World War II, as a factor conditioning individual behavior of American youth and military manpower policy. With the "zero-draft" now in effect, there still remains a need for the Navy to establish its own special appeal among eligible populations as a job and career opportunity, while operating within the range of legal and financial constraints applicable to all of the services. But no longer can the Navy rely heavily upon men who would rather "take a chance with the Navy" than be drafted into the ground forces. Furthermore, without leverage provided by the draft, all of the military services must now meet the same conditions of competition in the labor market as civilian employers do.

In this connection, it should be noted that there are at least two characteristics that once sharply distinguished between military and civilian life that are now far less salient. That is military pay and benefits now approximate parity with the civilian scale, and there is much less distinction between military and civilian codes of justice. Thus the attitudes toward, and satisfaction with the Navy, are today to a much greater degree than before likely to be a function of the same set of perceived life style and quality variables that apply in civilian occupations.

DESCRIPTION OF CAREER MOTIVATION MODEL

To develop the conceptual model interviews in some depth were used to cover the needs, motives, and perceptions of young men at certain key periods and situations in life. We spoke to young high school graduates who were interested and those who were not interested in joining the Navy; to junior college students likewise disposed; to recruiters who gave their perceptions of the civilians with whom they dealt; and to the sailors in various shortage ratings who had completed different lengths of service in their first term of enlistment.

Subsequent to the exploratory stages data were fortified by more systematic surveys.

What lies ahead is the development of a series of specifically targeted experimental tryouts aimed at improving recruitment and retention programs. Incorporated in each experiment, will be a follow-up study of organizational factors that determine how and to what extent results and recommendations are or are not put into practice.

Organizational Change Strategies

Two major types of organization change strategies are available. The first type can be called an "incentive-change" strategy (for example, raising pay). Here the assumption is that certain incentives can be found to alter workers' attitudes and to reinforce maintenance of new behaviors. The second type is an "organization-system change" strategy that implies that a change within the organization itself (such as a change in task structure and assignments) can lead to changes in attitudes and behaviors of members of the organization. So far we have stressed incentive change.

A series of "feedback conferences" has been incorporated into the plans in order to increase involvement of the Navy people who are active in recruiting and retention policy-making and operations, with the hope that they would become more experimentally oriented.

A Tour of the Model

With this introduction, here is a tour of the model of career motivation, with a few side excursions to bring in some of the data and conceptual materials that went into its construction.
It may be easier to think of this as a career influence and decision process that is revealed by following a prospective recruit through a number of choice points before and after he joins the Navy.

For this purpose one can think of the influence of specific Navy policy and practices upon the career motivation and socialization process as beginning when the individual first thinks about the possibility of a career in the Navy.

Figure 1 is the preliminary schematic that was sketched out before undertaking data collection. It shows a number of key factors affecting enlistment and re-enlistment decisions.

In the next set of figures there is a more complete and detailed representation. The following will indicate our present thinking about how these factors operate at each stage of the process. The model consists of three stages.

The first stage encompasses the recruiting phase, where preliminary socialization factors influence the individual's decision as to whether or not to enlist.

The second phase comprises the early stage of the first enlistment, where the recruit first makes contact with living and working conditions in the Navy. Typically, this represents a radical and rapid alteration of lifestyle requiring great readjustment. Recruit training is the opening chapter of this phase. It serves as an initiation rite designed to provide the recruit with the basic skills, knowledge and attitudes pre-requisite for acculturation to the Navy and performance of assignments that are to follow. This stage continues through the period when the recruit reports for his first assignment at a ship or station (although advanced training may intervene).

Transition to the third stage occurs when the individual comes to feel that he comprehends the intricacies of life in the Navy. This is called the accommodation phase to indicate that the enlistee has come to grips with the Navy, and has now adjusted to carrying on a normal day-to-day existence in the organization.

These three stages are interdependent. That is, the nature of later stages is determined by earlier events. Also, what happens later may lead to a reinterpretation of what took place during the early stages.

Recruiting and Initial Socialization Influences

As shown in Figure 2a, Block 1, a number of different factors may operate to influence a man's decision to enlist in the Navy. Major roles are played by a man's peers and parents. The man's own short-term and long-term interests have a part in determining whether he perceives the Navy to be relevant or irrelevant to his future aims. Travel, job training and educational opportunities--traditional appeals of the Navy--are still important influences in enlistment decisions. But, few people have much knowledge about actual opportunities that are available, and most individuals therefore have only a vague image of the kinds of training the Navy can offer. Such ambiguity and uncertainty decreases the likelihood that a man will give active consideration to the Navy as a viable job or career option (Block 1a). For other individuals, the Navy may be viewed as worthy of further exploration (Block 1b).

One particularly relevant contextual factor is the American cultural ethos that has always tended to differentiate the role of an enlisted man from that of an "educated person" (cf. Stouffer, et al., 1949), except to a degree during World War II when the nation was under direct attack and compulsory military service was well nigh universal. Thus, the fact that youth in our society are becoming increasingly educated, and greater numbers of men enter college or junior college after high school, tends to work against a man's enlisting in the Navy. (The median education of this generation is 12.7 years and more than half of the youth population starts college.)

In addition to increased societal emphasis on education, today's youth also place considerable value on the freedom to make their own decisions. As Levinson (1973, p. 76) has described this change: ". . .we are in the midst of a world-wide social re-evaluation, the central thrust of which is the demand of all people to have a role in their own fate." This is a prevailing influence in the recruiting process, since the military services are commonly believed to severely curtail a person's exercise of "fate control." To the extent that an individual subscribes to these changing values and is obtaining higher levels of education, a decreased interest in the Navy as a career can be predicted, unless convincing changes were to take place affecting relevant aspects of the Navy's image.

Given that the man is lead to explore the Navy, he then visits a recruiter. Most typically the individual who visits a recruiter knows very little about the career possibilities available to him in the Navy (or elsewhere for that matter). In general, he appears to be looking for a job rather than a career. That is, he is not intent upon making a long-term commitment to some particular vocation; rather he is trying to find himself, and at the same time obtain training and experience that will enable him to make a career decision later on.

These findings suggest that despite his lack of concrete direction regarding the sort of job he would like, the typical individual who gets as far as the Navy Recruiting Station has all but made up his mind that he is going to enlist in the Navy, even before he sees a recruiter. What he is usually seeking from this contact is to establish a sense of direction and gain some meaningful knowledge regarding working options and purposeful activity available in the Navy; that is to say grounds for confirmation rather than persuasion from the recruiter.

Concentration on the recruiter getting immediate results may have obscured awareness of important long-range behavioral implications. The recruiter's immediate influence is not evident in persuading a man to enlist so much as it is in giving the enlistee information about the Navy. The typical prospect first decides that he wants to enlist and then seeks out a recruiter to supply him with information regarding Navy requirements, qualifications, and the choices he can make. The prospect then proceeds to fill out forms and take tests, all the while not having a clear idea of what he would like to do when he actually enters the Navy. It is usually only after the candidate is found to meet Navy qualifications that the recruiter discusses available options with him. These discussions follow a certain predictable pattern, because the recruiter's goal is to enlist the individual and because the Navy's needs are quite specific regarding the number of men needed in particular occupational specialties at a particular time.

So it is to be expected that the recruiter's contribution to the preliminary socialization process takes the form of presenting the Navy in its most favorable light.

He reacts to cues supplied by the applicant more often than he initiates structure. Thus, if the prospect states his belief that recruit training is difficult, the recruiter is likely to agree, but point out that such training is good for him. In other words, the recruiter is apt to selectively reinforce images presented to him by the prospective enlistee (see Block 2b), trying to cast them in affectively positive terms (e.g., "being at sea is romantic" rather than "being at sea separates you from your family and friends.") The recruiter more often seems to be concerned with sweeping obstacles out of the way of the prospect--rather than to supply motive power to it. He tries to maintain the man's momentum toward enlistment.

A second feature of the recruiter's selective reinforcement procedure is dictated by the Navy's manpower needs. If the individual's interests lie outside those fields currently enjoying high priority, the recruiter steers the applicant (see Block 2b) into another field that is more immediately essential to the needs of the service.

The hypothesis is that insofar as the individual already inclines to enlist, but has little concrete knowledge about what the Navy is like and the actual array of options open to him, he is highly susceptible to the recruiter's influence when it comes to developing pictures of life in the Navy and to selecting a particular career field in the Navy. He is not in a position to critically evaluate the recruiter's description and recommendations. Later on he learns of other options that may actually have been available, but since his career goals were not fixed to begin with, the recruit may have initially accepted this situation as necessary. But when he comes to realize the full significance of his job choice, and when he then reports his reactions to others, a very different tale may be told.

Thus, in addition to the apparent influence of the recruiter at the enlistee's first choice point, the model suggest that there are other outcomes of the preliminary socialization process that may crucially affect the later development of career motivation.

In general, most individuals who begin their enlistment have a highly positive and idealized image of the Navy and its programs. Specifically, the prospective recruit often feels that by joining the Navy he is assuring himself of playing a masculine role by doing rigorous work (i.e., "doing a man's job."). He also probably believes that by joining the Navy, the work he will be doing will be important and will have some definite purpose (e.g., the defense of his country). Secondly, the recruit usually believes that the Navy operates with efficiency and discipline typical of the military attributes which he probably hopes to adopt as his own. Third, he has been told that the Navy and other military services have good leadership, and that supervisors in the Navy, more than those found in private industry, know what they have to do and how to get it done. Fourth, he is inclined to believe that by joining the Navy he will be able to develop valuable job skills that will be useful later on, particularly when he returns to civilian life.

These beliefs and perceptions of the Navy serve as the backdrop against which later events are evaluated. To the extent these are overly idealized, negative reactions to Navy experiences develop.

Early in the First Enlistment: Recruit Training and First Duty Station

The kinds of expectancies the individual had regarding life and work in the Navy come into play at this stage. During the individual's recruit training (see Block 4), it is quite likely that many of his expectations are reaffirmed (see Block 4b). That is, he engages in physical training which probably fits with his idealized image of what happens during boot camp. However, for some, the physical training probably results in an expectancy disconfirmation (see Block 4a) since the Navy is perceived by many to be less physically oriented than the other services. (Gilbert, 1972).

After boot camp a variety of expectancy disconfirmations are likely as the individual compares his expectations with the "real" Navy. This particular reality confrontation is first likely to occur when the recruit is assigned to his Class A school. Many of those interviewed claimed that during classification interviews, they were assigned to a school other than the one they believed they had been promised (see Block 4a). Whether or not this belief is factually based, the negative affect, as indicated in Figure 2c, would lessen interest in re-enlisting. (It should be noted that "their choice" in many instances was not one that they had made in advance of being recruited. Their choice of schools was a product of interaction with the recruiter--i.e., the recruit had accepted the recruiter's choice as his own.)

During his first duty assignment (see Block 5), the man's expectations concerning Naval leadership become quite salient. As noted previously, indoctrination during recruit training aims to reinforce the expectation that supervisors will be models of a behavioral ideal.

Instead, a second expectancy disconfirmation may occur (see Block 5a). For many men, officers come to be perceived as indeed fallible mortals, who can be inefficient or unmotivated, and who seem at times to be primarily concerned with asserting their authority and power. In addition, since the enlisted man has received technical training in his occupational field, he may see that he has technical competence superior in some respects to that of his officers. When officers appear to give inappropriate orders due to lack of knowledge, credibility and respect suffer. Counterproductive socialization inputs during recruiting and recruit training that inflate the enlisted man's expectations increase the likelihood of expectancy disconfirmation when the individual actually works with Navy leaders.

When expectancy disconfirmation and deflation occur there is "backlash". They dispose the sailor to a "negative set" toward the Navy in general, and a lessened likelihood that individuals will want to reenlist. These results are consistent with previous findings (Glickman, 1961), showing that many men become seriously disenchanted when they first confront the reality of Navy life after recruit training.

Along this line I might suggest that perception of a disconfirmation gap or dissonance is perceived more instensely by relatively new members of the Navy, because in their eyes the military is seen as a highly autonomous, self-sufficient, and higly controlled system. If conditions are unsatisfactory they ask, "Why can't something be done about it?" Because they believe that top officials have the power to effect almost any change that they really want to, their expectations and disconfirmations may tend toward magnification.

The model indicates that among those individuals not subjected to expectancy disconfirmation (see Block 5b) would be those individuals more likely to re-enlist.

Preliminary organizational socialization (by the recruiter and in recruit training) that more honestly reflects life and working conditions in the Navy might in the aggregate lead to enhanced career motivation. The "hard sell" often has dysfunctional consequences. This suggestion is supported by the work of Weitz (1956) and Wanous (1972), where it was found that more accurate job expectations, including knowledge of negative job aspects, led to a lessening of turnover.

Accommodation Phase

As the enlisted man assimilates the cognitions and perceptions of the Navy generated by reality-testing of his expectations, he engages in adaptation processes through which he attempts to accommodate his life style to the requirements of the Navy and his personal needs (see Figure 2c, Block 6). Cognitive dissonance processes are activated (Festinger, 1957). Self-fulfilling prophecies take hold.

For those who enter the accommodation phase with a "negative set," this phase tends to involve cumulating grievances; where the individual may actively seek out, selectively retain in memory, or rewrite history to provide reinforcement for his predominately negative view. In which case the accommodation phase serves as a holding stage. The men does what he has to do to get by, and essentially waits out his obligation. Since far more men intend to, and actually do "get out" of the Navy than do "stay in," the environment naturally supplies more negative than positive reinforcements.

The adaptive processes are, of course, different for those who enter this phase with a predominately positive view of the Navy. The experiences during this time probably have their greatest decision-making impact on those who are "open-minded;" whose intentions have still not crystallized.

An important aspect of the accommodation phase is that it takes place during a period of considerable personal change. These men mature from late adolescence (at age 17, 18 or 19) to manhood; many get married and begin a family by the time they are 22 or 23. Such personal changes alter men's disposition toward the Navy and the likelihood of re-enlisting (see Blocks 7a and 7b). Many of their values and career interests change and become more differentiated.

As noted earlier, many of the men who visit a recruiter have little clear knowledge of what they would like to do with their lives. They enter the Navy with the idea that they will learn a trade and "find themselves." They come to conclusions regarding their career goals as a result of knowledge and experience acquired only after they get into the Navy. It is for many the first time that they engage in sustained job activity as part of a larger organizational effort and are exposed to value systems of a large number of people. Through this exposure they are able to examine their tentative career interests in long-range perspective. So, it is clear that organizational changes instituted by the Navy to enhance career motivation must be developed against the perspective of a changing, developing individual.

There are several examples which can be cited. To begin with, look at those who get married during the first tour of duty; this change has several effects. First, and perhaps most critically, the separation endured by a married couple in itself most often has aversive consequences. And then, the married man more sharply confronts a lack of control over the course of his life. Among his civilian counterparts, typically, decisions regarding where to live and how to raise a family are made by husband and wife. In the Navy, however, they lack ultimate control over this class of decisions, thus leading them to feel powerless and too dependent upon decisions of a impersonal authority. Furthermore, enforced absence deprives the man of considerable exercise of authority and influence in the role of father, and also deprives the wife of psychological support in the raising of children.

Related to this is the "burr effect." As his spouse exerts pressure, the sailor begins to look at factors, such as leadership, with a more critical eye, and he becomes less willing to tolerate leadership practices which fall short of his (or her?) ideal. On the other hand, a factor that assumes increasing importance with marriage is that particular Navy benefits are taken more seriously. Thus, the availability of insurance and medical benefits are viewed quite positively by married enlistees, as are increased allowances for family men. Job security becomes more highly valued. These constitute positive counterbalancing appeals for some married enlisted men.

During the first enlistment the overall result of these changes is lessened career motivation. While the individual undergoes change, he perceives that the Navy does not change to meet his newly developed needs. The "needs of the service" seems to be a demand for adaptation that is viewed by most men as one-sided and inequitable, and leads them to perceive re-enlistment as undesirable.

Many large organizations may be characterized as "inflexible." But this need not be the case for the Navy. There are a number of avenues that might be followed to allow greater flexibility of career goals and lifestyle. For example, it might be feasible to make cross-training available so that an enlisted man is not forever "locked in" to a job without opportunity for change during his enlistment. Greater flexibility might be built into the system to allow for change in rating, assuming he is no longer interested in his initial job choice and can fulfill the requirements and obligations associated with a shift to a preferred alternative.

RECOMMENDATIONS

From the very beginning of their enlistment, men come to perceive that they lack "fate control" (Thibaut & Kelley, 1959) over important decisions.

In the past, it has been taken for granted that the exigencies of military service leave little room for modification of the Navy's practices to alter the image in terms of more flexible decision-making, initiative-taking and individual participation. Emphasis has been upon providing tangible incentives and rewards to compensate for these "inevitable" constraints more than upon seeking workable organizational modifications.

So, if a man does not like a civilian job he can "get out," but in the military service he is "locked in." This is accentuated in the sea-going Navy, where men are restricted to the same physical and social environment and round-the-clock demands. We see fate control as a thematic overlay covering a large part of the cognitive map of career motivation. It would seem worthwhile for the Navy to make a realistic determination of the imperative requirements to set the boundaries within which individual and organizational behavior can be modified. Then can follow a realistic determination of the personal and organizational options that can be traded between the individual and the Navy.

Innovations Affecting Recruiting

Potential applicants often approach a recruiter hesitantly and skeptically. They are not confident of their ability to make a correct decision, and they put no great trust in the recruiter--a stranger with presumed vested interests. The risk of a "mistake" is high, regardless of whether the mistake can ultimately be blamed on one's self or the recruiter. The consequences of a mistake are immutable; you are stuck with it.

There are a number of steps that conceivably can be taken to reduce fears associated with enlistment decisions. Well-educated applicants are perhaps the most sensitive to such anxieties, and they have more alternatives open to them. So, changes might have the greatest impact on the most qualified prospects.

In a recruiting framework there are three particular steps that the Navy might undertake: the development of a career behavior information system, the implementation of a vocational counseling program, and the placing of more effort on appealing to prospects in groups not now being given a great deal of attention, such as junior college students and younger high school students (ages 15-16).

A career behavior information system. Most of the information available regarding Navy careers is concerned with educational/background requirements for specific Navy specialties, the kinds of training applicants will receive and how much time they must invest to enroll in different career programs.

The Navy could develop a more complete career behavior information system that could describe specific Navy jobs in terms of their behavioral characteristics and career potential, both in and out of the Navy. Characteristics could be compiled to develop profiles for each rate, which could then be supplied to applicants to provide them with more complete information on which to make a career choice.

Illustrative of dimensions to be included are: (a) Time spent interacting with various types of others; (b) Extent of supervision of others; (c) Development of unique solutions to problems; (d) Typical job working conditions, tools, equipment, location, and (e) Hazards and safety factors.

This information system could have a number of benefits: (a) By reducing ambiguities associated with deciding on a career path, it might bring otherwise uninterested individuals to explore possibilities in the Navy; (b) By enabling applicants to make more accurate decisions, reducing the likelihood of future unrealistic expectations and job dissatisfaction; (c) By increasing awareness of how Navy skills are transferable to civilian occupations; (d) Providing information to recruiters as well as school guidance counselors.

Enlistment counseling. Another solution for some of these problems might be to provide applicants with professional vocational counseling in order to assess their personal needs and capabilities, as well as informing them of options available in the Navy.

This could be established within the framework of the existing recruiting network. Applicants would first present themselves to the recruiter as they ordinarily do. Following some initial discussion with the recruiter and after providing the usual biographical data and taking the tests now in use, the applicant would be offered the option of going to a vocational counselor who would review the entire situation with the applicant, discussing his capabilities in terms of both civilian and Navy work, immediate and long term. The applicant could then return to the recruiter to finalize his decision to get in or stay out.

A clear distinction should be made between the role of the recruiter and that of the independent vocational counselor. The recruiter's primary job is to match the applicant with available Navy jobs. The counselor is primarily concerned with the needs and goals of the client, through selection of an appropriate job or career path in the Navy or elsewhere.

This kind of program would appear to have a number of benefits. A greater proportion of individuals might expose themselves to a recruiter in order to obtain such counseling. An important barrier to overcome is that of getting men to begin considering the Navy.

The counseling program could reduce anxiety associated with making career decisions. The applicant is less likely to feel that he is faced with a system that is primarily concerned with meeting organizational goals, and only incidentally concerned with individual considerations. He may be expected to feel that he was more fully engaged in making his own deliberate choice, and thus accept it more fully thereafter.

Furthermore, many parents bemoan the fact that adolescents lack a sense of direction and are unable to "find themselves." Vocational counseling would be of interest to such parents, who, in turn, might be more disposed to exercise indirect or direct influence upon their sons in favor of the Navy, or at least toward availing themselves of the free counseling service.

The overall result of implementing a career behavioral information system and a vocational counseling program would be to: (1) increase the credibility of the Navy's recruiting system; (2) enable individuals to have more information available for decision-making; (3) increase the personal acceptance of the choices made, and (4) reduce the perception of the Navy as an inflexible organization.

New recruiting populations. This illustrates, but does not exhaust the possibilities affecting recruiting that we have considered in our reports, such as the possibilities of aiming appeals at junior college populations on the one hand, and pre-eligible 15 and 16-year-olds on the other.

Innovations Affecting Re-enlistment

Within the framework of innovations aimed at influencing re-enlistment intentions and career decisions, two courses of action seem appropriate: (1) "reducing the negative" results of false expectations, (2) "accentuating the positive" through better post-enlistment career counseling.

Improving validity of expectations conveyed by recruiters and by recruit training. While numerous sources may be responsible for generating inappropriate expectations among recruits, the influence generated through recruiters and recruit training are most amenable to direct administrative intervention. There is a need to further examine these expectations and pinpoint the expectations that need to be altered to conform more closely to the "reality" of the Navy.

After they are trained, recruiters and instructors could give more explicit and realistic information to prospects and recruits regarding the conditions they would be likely to find in the service. A comparative test could be made of the hypothesis that those with more realistic expectations are more favorably disposed toward Navy careers.

Improving post-enlistment career counseling and career flexibility. A number of enlisted men do not wish to re-enlist because of feelings of powerlessness or lack of fate control.

Here are some examples. Once enlisted men have chosen a particular speciality, there is little opportunity for them to change. They see themselves in a management system where they have little influence on decisions that affect their lives.

As a means of reducing feelings of powerlessness among enlisted personnel, a number of options seem to be available.

It should be possible to expand the role and duties of career counselors to enable them to provide more meaningful career information and more tangible options. Thus, a variety of options could be made available to enlisted men by career counselors, in the same way that recruiters have authority to make certain binding commitments. These could provide greater flexibility than at present. For example, one could evaluate the effect of shorter or indeterminate enlistments on career motivation. Naturally, the longer the period of time committed by the individual, the more benefits he would receive as Quid Pro Quo.

Other options could include more opportunities to change fields of specialization. Greater flexibility of time commitment might be brought about by: (1) making sabbatical leave available after a minimum period of service; (2) providing for leave without pay. These options would allow men to alternate between the civilian world and the Navy, increasing the individual's job skills and maximizing his potential for both civilian and Navy organizations.

Implementing options such as these might have several beneficial outcomes. For example, men who were placed in the "wrong" specialty (from the man's point of view), could rectify such "errors" by changing rates and obtaining additional training instead of getting out of the Navy, at a time and dollar cost less than required to find and train a replacement. Permitting individuals to commit themselves for shorter or indeterminate terms would allow them to perceive that they have some reasonable measure of "fate control" in the Navy. Moreover, if men were not forced to make absolute and final "yes-no" decisions regarding staying in the Navy, more individuals might be inclined to remain longer.

Work in Progress

As part of the current research on the career motivation process, taking the model into consideration, many of the incentives that will be experimented with will focus on reducing the perceived inflexibility of the Navy, as well as on increasing the benefits received by individuals as a function of the extent of their commitment (e.g., Quid Pro Quo).

Since this is a state-of-the-art presentation, I have focused on hopefully heuristic content, without qualifiers and caveats. Further experimentation will subject these ideas to harder tests.

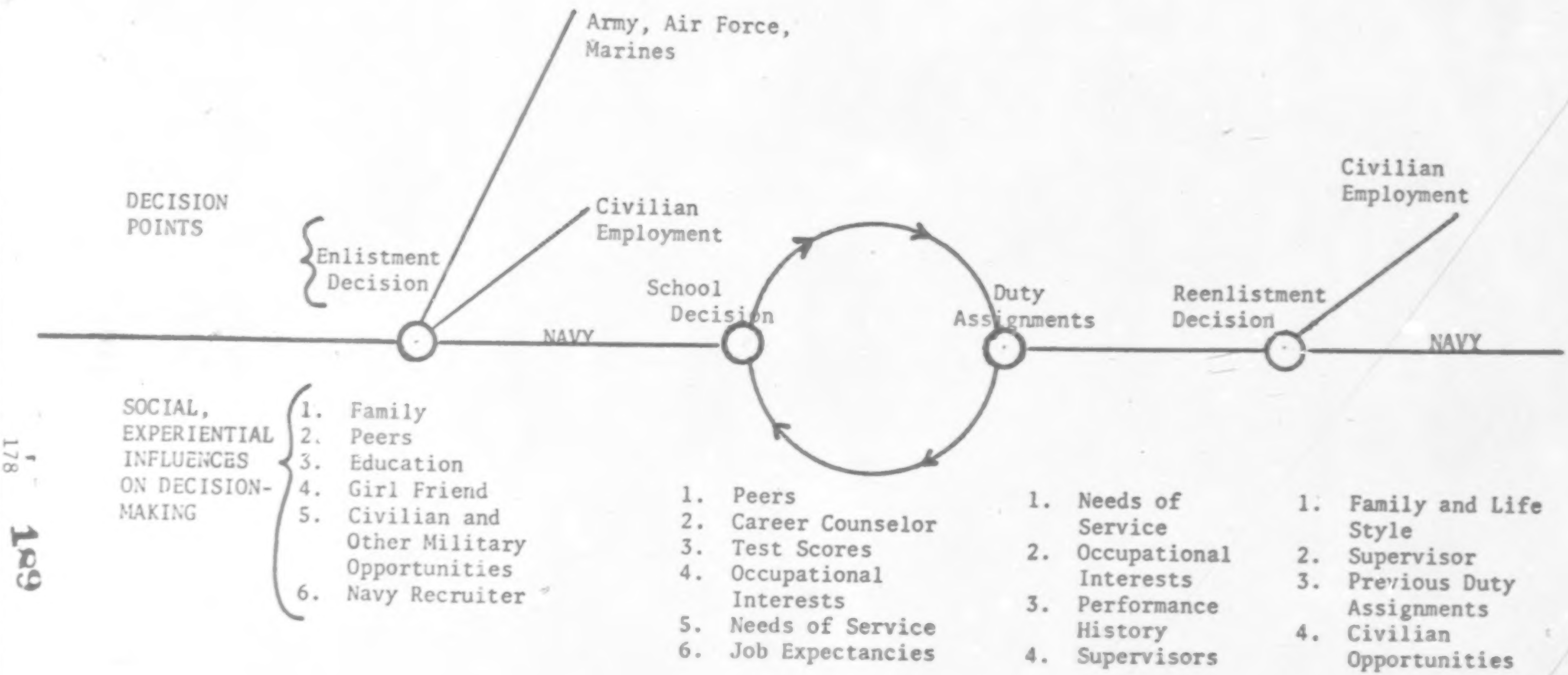
Army, Air Force,
Marines
DECISION
POINTS
Enlistment
Decision
Civilian
Employment
NAVY
School
Decision
Duty
Assignments
Reenlistment
Decision
Civilian
Employment
NAVY
SOCIAL,
EXPERIENTIAL
INFLUENCES
ON DECISION-
MAKING
1. Family
2. Peers
3. Education
4. Girl Friend
5. Civilian and Other Military Opportunities
6. Navy Recruiter
1. Peers
2. Career Counselor
3. Test Scores
4. Occupational Interests
5. Needs of Service
6. Job Expectancies
1. Needs of Service
2. Occupational Interests
3. Performance History
4. Supervisors
1. Family and Life Style
2. Supervisor
3. Previous Duty Assignments
4. Civilian Opportunities

Figure 1. Model of career motivation process in the Navy, including key decision points and influential factors (from Interim Report, June 1972).

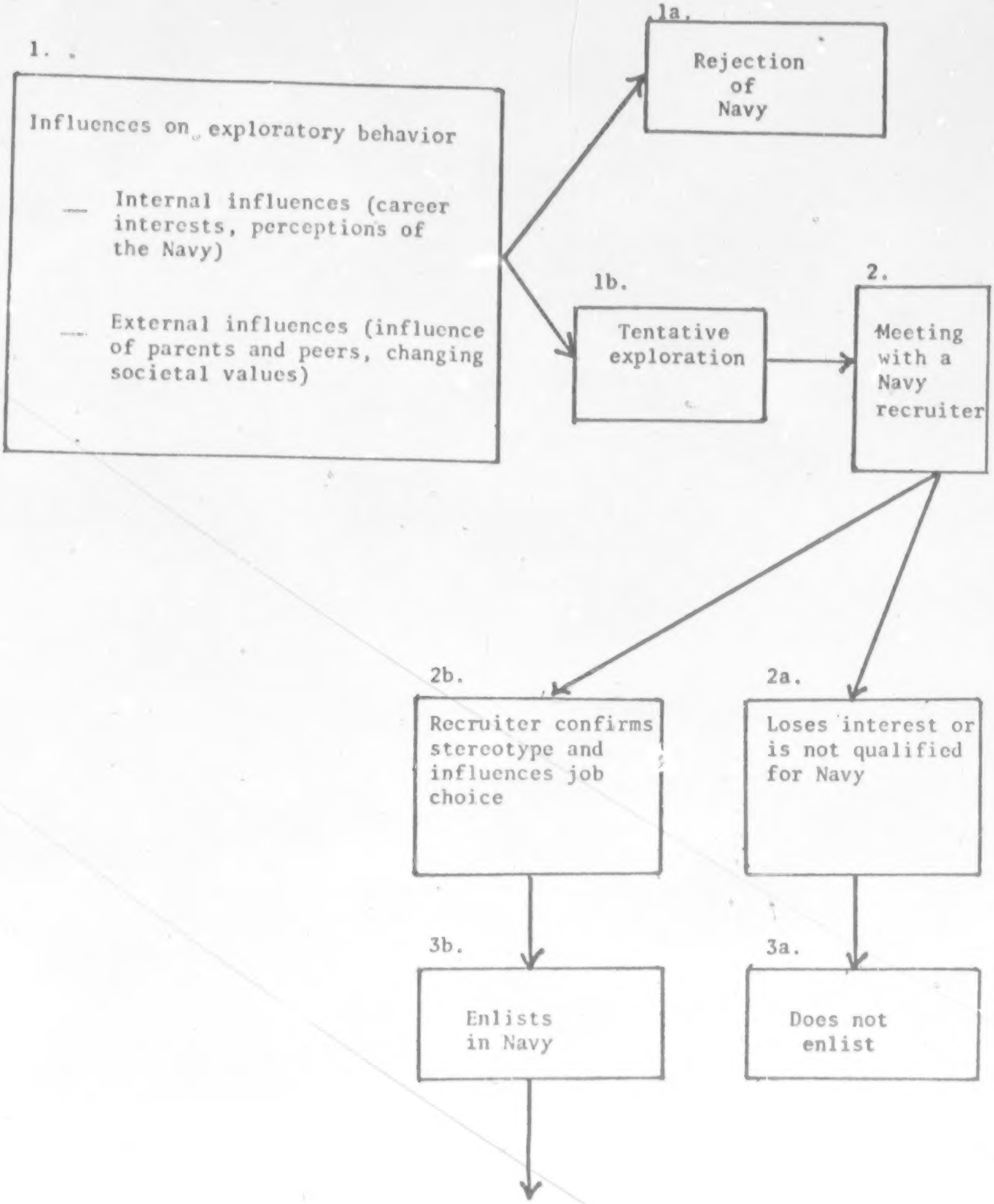
1.
Influences on exploratory behavior
— Internal influences (career interests, perceptions of the Navy)
— External influences (influence of parents and peers, changing societal values)
1a.
Rejection of Navy
1b.
Tentative exploration
2.
Meeting with a Navy recruiter
2b.
Recruiter confirms stereotype and influences job choice
2a.
Loses interest or is not qualified for Navy
3b.
Enlists in Navy
3a.
Does not enlist

Figure 2a. The career motivation and socialization process model: Phase I - Recruiting

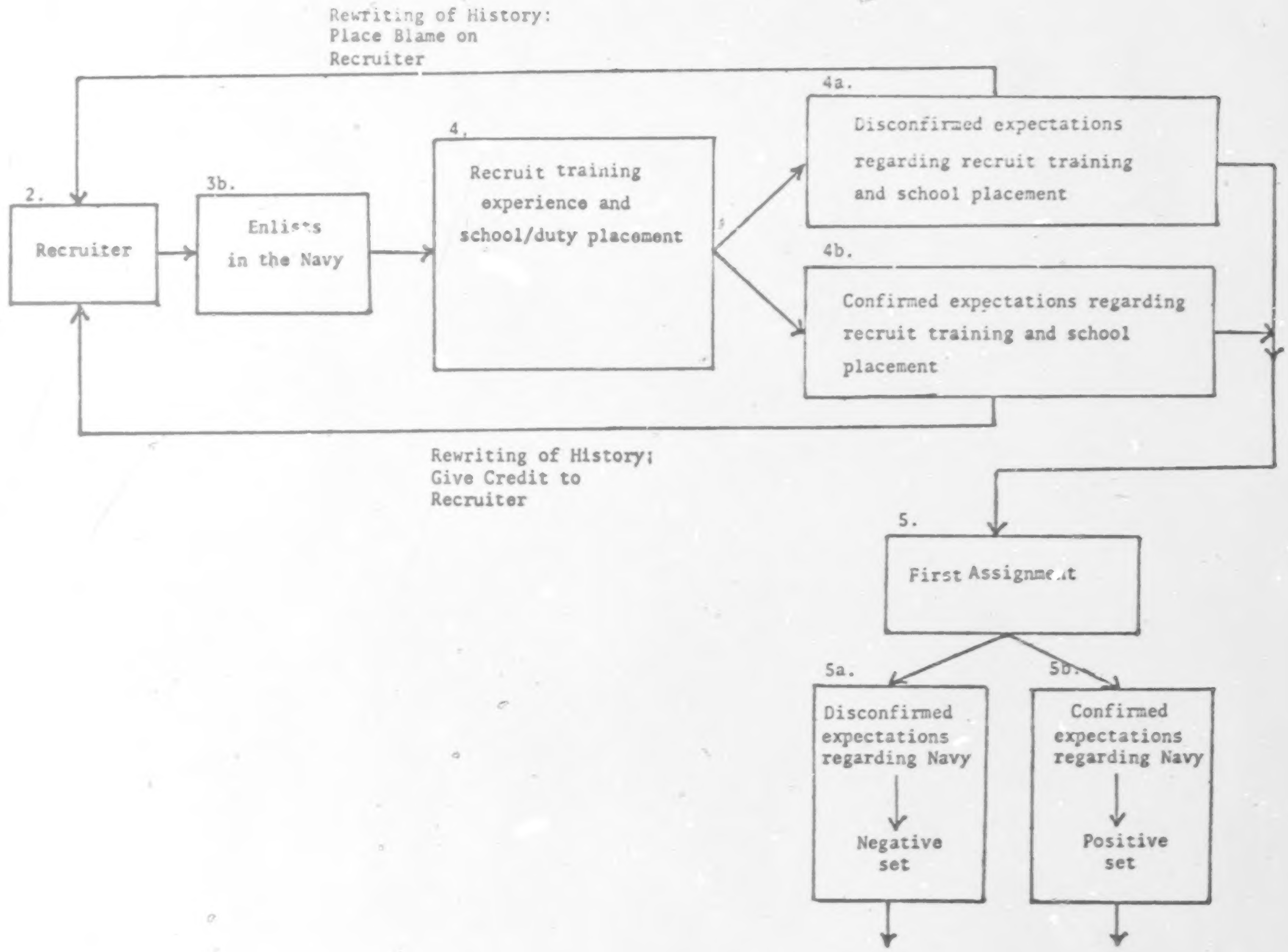
Rewriting of History:
Place Blame on
Recruiter
2.
Recruiter
3b.
Enlists
in the Navy
4.
Recruit training
experience and
school/duty placement
4a.
Disconfirmed expectations
regarding recruit training
and school placement
4b.
Confirmed expectations regarding
recruit training and school
placement
Rewriting of History;
Give Credit to
Recruiter
5.
First Assignment
5a.
Disconfirmed
expectations
regarding Navy
Negative
set
5b.
Confirmed
expectations
regarding Navy
Positive
set

Fig. 2b, The career motivation and socialization process model: Phase II - Early stage of first enlistment

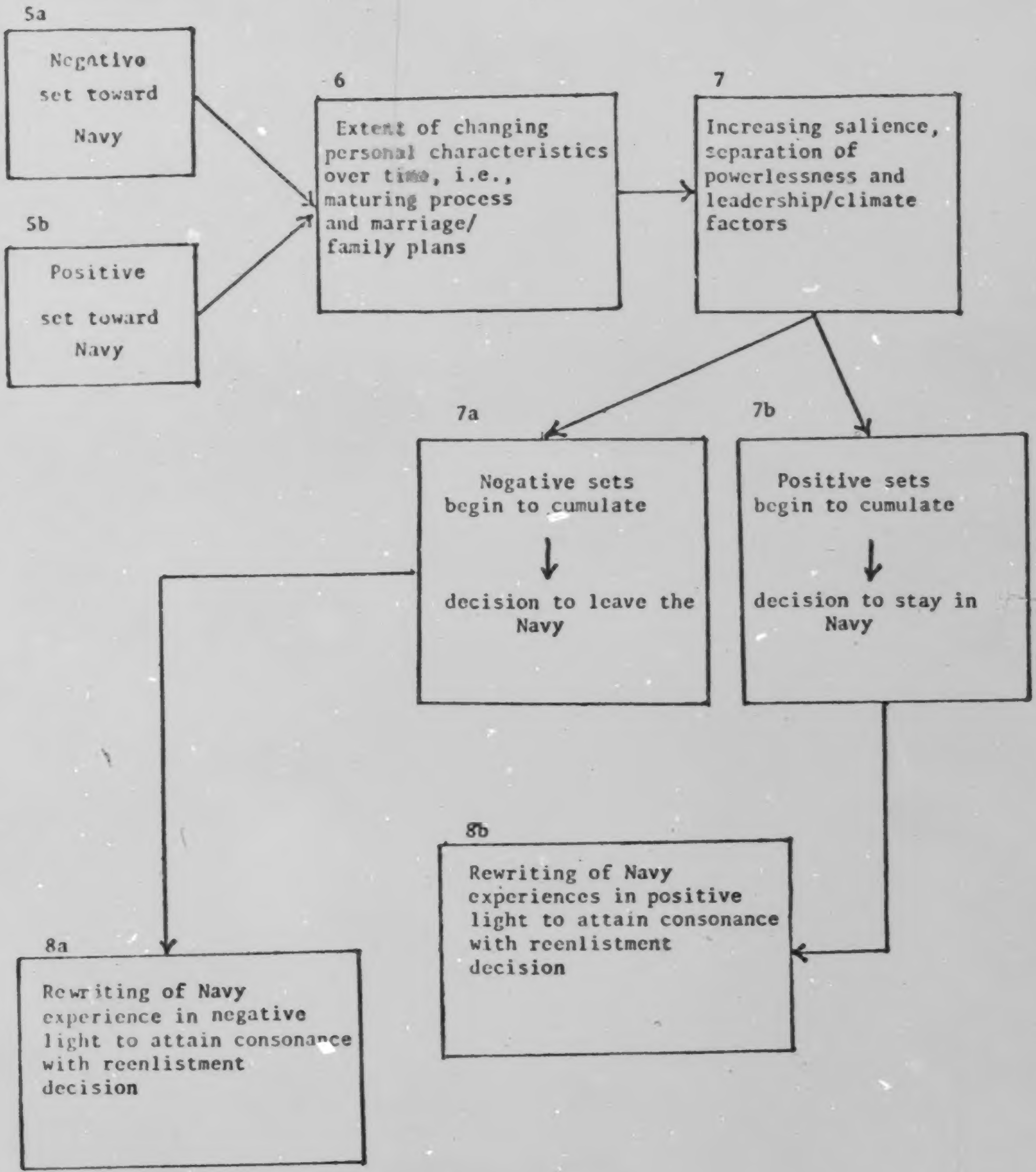
5a
Negative set toward Navy
5b
Positive set toward Navy
6
Extent of changing personal characteristics over time, i.e., maturing process and marriage/family plans
7
Increasing salience, separation of powerlessness and leadership/climate factors
7a
Negative sets begin to cumulate
decision to leave the Navy
7b
Positive sets begin to cumulate
decision to stay in Navy
8a
Rewriting of Navy experience in negative light to attain consonance with reenlistment decision
8b
Rewriting of Navy experiences in positive light to attain consonance with reenlistment decision

Figure 2c. The career motivation and socialization process model: Phase III - Accommodation

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SECTION III

ORGANIZATIONAL EFFECTIVENESS

Dr. Marvin D. Dunnette, Chairman

Research into the Nature of Organizational Effectiveness: An Endangered Species	Dr. John Campbell
Modeling, Measuring and Monitoring Organizational Effectiveness	Dr. George Milkovich
Social-Psychological Indicators of Organizational Effectiveness	Mr. Jerome L. Franklin
Prospects for Research on Organizational Climates	Dr. Roy Payne
Organizational Effectiveness: Discussant	Dr. James Arima

RESEARCH INTO THE NATURE OF ORGANIZATIONAL EFFECTIVENESS: AN ENDANGERED SPECIES?[1]

John P. Campbell[2]

The content of this paper is derived largely from a search of existing theory, research, and practice regarding something called the effectiveness of organizations. It is part of a larger effort to design a comprehensive series of research projects which, if carried out, would advance our understanding of organizational effectiveness by more than a random amount.

The purpose of these current remarks is to try to reflect the state of the organizational effectiveness art and make some tentative suggestions as to where things should go from here, if anywhere. Organizational effectiveness literature means literature which focuses on the organization or its major subunits as a degree of freedom rather than the individual. That is, a look at the criteria and determinants of organizational performance, not individual performance, although in the end this distinction became rather blurred. We also tried to keep a research point of view rather than attempting to codify all the prevailing practices that exist for changing organizational performance. This distinction also became blurred.

To search this literature the primary sources were followed back approximately 15-20 years. Beyond that secondary sources were relied upon, such as; books on organization theory and management or established literature reviews. Literature in the fields of sociology, psychology, political science, management, administrative and management science, industrial relations, and organization theory was searched as thoroughly as possible. The computerized abstracting services from Psychological Abstracts, NTIS, and DDC were also employed using a wide variety of key words (e.g., organization theory, effectiveness, performance, analysis).

The Literature: Descriptive Characteristics

To further aid in setting the context, it might be profitable to describe briefly some of the parameters and trends that seem to characterize the organizational effectiveness literature.

1. First of all, most of it is discursive or theoretical in nature and not empirical. In a sense this is a recognition of the difficulty in doing systematic research in a domain where an entire organization is counted as just one degree of freedom. As a result most of the empirical work consists of case study type investigations and projects using many degrees of freedom quite often become classics in their own time.

2. Before the mid 1950's most of the systematic study of organizational effectiveness was carried on by sociologists, and the primary mode of research was the case study. Philip O. Selznick's classic study of the TVA is an example (Selznick, 1966[3]). William Foote Whyte's (1948) examination of the restaurant industry is another. Blau (1955) and Gouldner (1954) were other major contributors.

3. March and Simon's (1958) classic analysis of organizations in terms of decision making and choice behavior ushered in the era of psychology and management science and the number of individual research projects increased as did the breadth and scope of theorizing about organizational effectiveness. Also, before the mid 50's specific concerns for organizational effectiveness were blended in with the general literature on organization theory. That is, effectiveness tended to take a back seat to questions of what an organization actually is, how many different kinds there are, how they develop, etc. A seminal point of departure was the 1957 Georgopoulos and Tannenbaum criterion study which set apart the measurement of effectiveness as a distinct topic. Theory and research concerning organizational effectiveness exhibited its greatest growth during the 60's. If this domain has had a golden era, the 60's are it. Very recently it has seemed to slow and even undergo a leveling out. At the same time the nature of the empirical research has seemed to shift from exploratory or "one shot" type studies to more programmatic efforts that are guided by some sort of theory. Two prime examples of the latter are the research conducted by Likert, Seashore, and Bowers at the University of Michigan's Institute for Social Research (Bowers & Seashore, 1966; Likert, 1967; Taylor & Bowers, 1972) and the series of studies produced by the English group at the University of Aston (Pugh, Hickson, Hinings, & Turner, 1968, 1969).

4. While research on organizational effectiveness seemed to be settling down to more interrelated studies based on some sort of conceptual framework, a parallel development has been the rapid rise in behavioral science based organization development. In general the field of OD is not research based but is practitioner oriented and directly concerned with making changes in organizational effectiveness using a variety of techniques; and although they often protest to the contrary, OD specialists do make fairly strong assumptions about what an effective organization should be like. These are discussed a bit later. In contrast to the research enterprise which seems to be coalescing around a relatively small number of conceptual models, the OD field has developed a bewildering variety of conceptual and operative models (Burke, 1973; Hornstein, Bunker, Burke, Gines, & Lewicki, 1971).

5. One final observation about the literature in this area is that there is a perceptible undercurrent of despair that has manifested itself among the research types in recent years. By contrast many of the OD practitioners seem to be in a state of euphoria. Organizational effectiveness is admittedly a complex topic and depending on your inner

strength it may look far too complicated to ever be resolved in any systematic way. The research questions of what is organizational effectiveness and how it is determined may yet go the way of the timber wolf (an endangered species), or worse yet, the aardvark (an extinct species).

Organizational Effectiveness as a Construct

Based on looking at all this literature, observing an occasional administrator, manager, or military officer, and listening to people talk about organizations, there appear to be two general points of view as to how one should assess organizational effectiveness. They have been given various labels but the most popular are the goal centered view and the natural systems view (e.g., see Ghorpade, 1971).

The goal centered view makes a reasonably explicit assumption that the organization is in the hands of a rational set of decision makers who have a set of goals in mind which they wish to pursue. Further, these goals are few enough in number to be manageable and can be defined well enough to be understood. Given that goals can be thus identified it should be possible to plan the best management strategies for attaining them. Within this orientation the way to assess organizational effectiveness would be to develop criterion measures to assess how well the goals are being achieved. There are a number of variations of the goal centered view. The management by objectives tradition (e.g., Odiorne, 1965, 1969) as it is usually practiced tends to fall in this category. The recently renewed movement toward cost/benefit analysis (Rivlin, 1971) is an ambitious attempt to assess the actual utility of accomplishing specific goals. During the 1960's the attempt to derive overall measures of military readiness (Hayward, 1968; Popper & Miller, 1965) is yet another variation.

The natural systems view appears to make the assumption that if an organization is of any size at all the demands placed upon it are so dynamic and so complex that it is not possible to define a small number of organizational goals in any way that is meaningful. Rather, the organization adapts the overall goal of maintaining its viability or existence through time without depleting its environment or otherwise fouling its nest. Thus to assess an organization's effectiveness one should try to find out if an organization is internally consistent within itself, whether its resources are being judiciously distributed over a wide variety of coping mechanisms, whether it's using up its resources faster than it should, and so forth. One implicit assumption that the people with this orientation seem not to always own up to is that to be effective the organization needs some theory or model that specifies the kinds of coping mechanisms that must be built and kept lubricated. It cannot prepare itself for literally everything. One clear example of such a natural systems model that incorporates specific a priori notions of what system variables should be assessed is the one developed at the University of Michigan Institute for Social Research by Likert and his associates (Likert, 1961, 1967). In the beginning the basic systematic variable was the degree to which subordinates participated in making the decisions which affected them, or to say it another way, the degree to which supervisors shared their influence. The list has since been expanded to include communication factors, motivational practices, and the like. The focus is on "people" factors and not on the state of the organization technology or its physical structure. The current state of the organization is measured via a questionnaire. The most recent formalization of the model and the current measurement instrument is described by Taylor and Bowers (1972). Other examples are those outlined by Argyris (1964), Blake and Mouton (1968), and Katz and Kahn (1966).

The principal point to be made here is that if an organizational consultant were to be parachuted to the deck of a ship and asked to assess the effectiveness of that organization, how he would begin the assessment would depend in part on which of these two points of view he had internalized. The goal oriented analyst would immediately seek out the principal power centers or decision makers on board and ask them to state their objectives. If he were wordly wise he would also employ techniques to reveal the actual operative goals of the organization as well as the publically stated ones. For example, the captain's formally stated goal might be to have his ship score high on a specific set of maneuvers. However, his operative goal might be to "look good enough to earn a promotion". For better or worse, once the consultant had the goals defined he would proceed to develop criterion variables that would measure how well the objectives (of either kind) were being met. The "validity" of a particular criterion for assessing the degree of attainment of a particular goal would be a matter of expert judgment. Keep in mind that goals are not criteria. One is a desired end state and the other is an operationalized continuum representing the degree to which the desired end state is being met.

If a natural systems oriented analyst were to fall from the sky he would not first ask what the organization was trying to accomplish. Rather he would nose around the ship a lot and ask questions, perhaps about the degree of conflict among work groups, the nature of communications, the level of racial tension, the percentage of billets that were filled by people with the appropriate level of training, what the commanding officer was trading away to get the personnel he wanted, the morale of the officers and crew, and the like. At the outset he would not be concerned with the specific tasks the ship was trying to perform but would be concerned with the overall viability and strength of the system. He would have some a priori notions of what the characteristics of a strong system are and he would center his questioning around those. For example, if he was from the Institute for Social Research he would most likely administer the Survey of Organizations questionnaire (Taylor & Bowers, 1972). Supposedly, if the ship turned out to be a strong and well balanced system, it should be equipped to pursue a wide variety of objectives and meet a wide variety of demands.

If both these analysts take their logical next steps their efforts will tend to parallel each other, if not actually converge. If the goal oriented analyst attempts to diagnose why an organization scores the way it does on the criteria he will soon be led back to system type variables. For example, perhaps the ship did not perform well in maneuvers because of racial tension on board. If the natural systems analyst wonders how various systems characteristics affect task performance, he very soon will be trying to decide which tasks are the important ones on which to assess performance. Unfortunately, in real life these second steps are often not taken. The goal oriented analyst tends not to look in the black box and the natural systems oriented analyst does not like to worry about actual task performance unless he's pressed.

Please note that the above dichotomy appears not infrequently in other forms and other places. It is very similar to the general notion of process vs. outcome research. Research on the employment interview is an example. For years the emphasis was on the interviewer's final judgment and its reliability or validity. Only recently have investigators looked at the process involved in the way the final decision is actually made. The process type studies have tended to show that interviewers have well defined stereotypes of a good applicant that may or may not match the requirements of the job, that negative information is given an inordinate amount of weight, and that the actual decision is made much earlier in the interview than anybody previously realized. There is a strong assumption underlying this research that if interviewers are trained to know their own processes and "improve" then the resulting employment decisions will be "better".

What Does the Literature Show?

One of the initial objectives was to identify and catalog the major variables that have been used to do research on or theorize about organizational effectiveness. Consequently, every time some characteristic of an organization was used as one of the focal points of a study, theory, or other pronouncement we noted its definition, if there was one, and the context in which it was used. Two judges then independently sorted the variables into relatively homogeneous categories and gave a general name and definition to the category. We argued a fair amount about how many categories there should be, what they should be called, and how they should be arranged in relation to one another. The categorization has its obvious faults but perhaps we can still use this rough taxonomy to illustrate a few relevant points. It appears as Table 1.

Table 1

A Listing of the [illegible]or Characteristics of Organizations around which the Literature on Organizational Effectiveness (broadly defined) seems to be focused.

I. DEPENDENT VARIABLES

Overall Effectiveness. The degree to which the organization is accomplishing all its major tasks or achieving all its objectives. A general evaluation that takes in as many single criteria as possible and results in a general judgment about the effectiveness of the organization.

Quality. The quality of the primary service or product provided by the organization. This may take many operational forms, primarily determined by the *kind* of product or service provided by the organization.

Productivity. The quantity of or volume of the major product or service that the organization provides. Can be measured at three levels: individual, group, and total organization. This is not a measure of efficiency, no cost/output ratio is computed.

Readiness. An overall judgment concerning the probability that the organization could successfully perform some specified task if asked to do so.

Efficiency. A ratio that reflects a comparison of some aspect of unit performance to the costs incurred for that performance. Examples: dollars per single unit of production, amount of down time, degree to which schedules, standards of performance, or other milestones are met. On occasion, just the total amount of costs (money, material, etc) a unit has incurred over some period can be used.

Profit or Return. The return on the investment used in running the organization from the owners' point of view. The amount of resources left after all costs and obligations are met, sometimes expressed as a percentage.

Growth. An increase in such things as manpower, plant facilities, assets, sales, profits, market share, and innovations. A comparison of an organization's present state with its own past state.

Utilization of Environment. The extent to which the organization successfully interacts with its environment, acquiring scarce, valued resources necessary to its effective operation. This is viewed in a long term, optimizing framework and not in a short term, maximizing framework. For example, the degree to which it acquires a steady supply of manpower and financial resources.

Stability. The maintenance of structure, function, and resources through time, and more particularly through periods of stress.

Turnover or Retention. Frequency or amount of voluntary terminations.

Absenteeism. The frequency of occasions of personnel being absent from the job.

Accidents. Frequency of on-the-job accidents resulting in down time or recovery time.

Morale. A predisposition in organization members to put forth extra effort in achieving organizational goals and objectives. Includes feelings of commitment. Morale is a group phenomena involving extra effort, goal communality, and feelings of belonging. Groups have some degree of morale, while individuals have some degree of motivation (and satisfaction). By implication, morale is inferred from group phenomena.

Table 1
DEPENDENT VARIABLES (continued)

Motivation. The strength of the predisposition of an individual to engage in goal-directed action or activity on the job. This is not a feeling of relative contentment with various job outcomes as is satisfaction, but more akin to a feeling of readiness or willingness to work at accomplishing the job's goals.

Satisfaction. The degree of feeling of contentment felt by a person toward his organizational role or job. The degree to which individuals perceive they are equitably rewarded by various aspects of their job situation and the organization to which they belong.

Internalization of Organizational Goals. The acceptance of organizational goals by individuals and units within the organization. Their belief that the organization's goals are right and proper.

Conflict - Cohesion. A bipolar dimension defined at the cohesion end by an organization in which the members like one another, work well together, communicate fully and openly, and coordinate their work efforts. At the other end lies the organization with verbal and physical clashes, poor coordination, and ineffective communication.

Flexibility - Adaptation. The ability of an organization to change its standard operating procedures in response to environmental changes, to resist becoming rigid in response to environmental stimuli.

Evaluations by External Entities. Evaluations of the organization or organizational unit by those individuals and organizations in its environment with which it interacts. Loyalty to, confidence in, and support given the organization by such groups as suppliers, customers, stockholders, enforcement agencies, and the general public.

II. INTERVENING VARIABLES

Differentiation. The degree of segmentation, fragmentation, or division of an organization along one or more factors such as function or task hierarchy. The measuring of this variable provides some idea of probable need for coordinating or integrating efforts (the more differentiated, the more coordination needed).

Job Complexity vs. Specialization. A job is complex to the extent that it is not routine, requires close attention, or is complicated. Some ways of measuring this are: number of separate tasks performed, number of specialized operations performed at once, whether or not combined effort is needed, degree of predictability of work demands, amount of discretion, and extent of responsibility.

Goal Consensus. Goal consensus is the degree to which all the individuals in the organization perceive the same goals as the goals for the organization. This is distinct from an actual commitment to those goals.

Table 1
INTERVENING VARIABLES (continued)

Role and Norm Congruence. The degree to which the members of an organization are in agreement on such things as what kinds of supervisory attitudes are best, performance expectations, morale, role requirements, etc. This variable is a kind of indicator of "life style agreement."

Organizational Climate. A description of the organization's current "state" as perceived by the organization members. This variable is usually viewed as consisting of many different facets that combine to form the overall perception of "climate" by an individual. The number and content of the facets is still a matter for argument, but there is some agreement on the following:

- *Individual autonomy* or the freedom of the individual to be his own boss and not having to be constantly accountable to higher management.
- *Structure* or the degree to which the objectives and methods for the job are established and communicated to the individual by superiors.
- *General reward orientation* or the level of rewards that are available.
- *Consideration and warmth* or the support in a human relations sense that a manager receives from his superiors.
- *Cooperation vs. conflict* which refers primarily to the relationships amongst peers of people in the immediate work group.

Technology. The nature of actions that an individual performs upon an object, with or without the aid of tools or mechanical devices, in order to make some change in that object.

Structure. The actual specifications for the duties of individual jobs and the specifications for how jobs should relate to each other (e.g., functionally, hierarchically, etc.).

Size. The total number of people in the organization or subunit.

Stress. The degree of aversive stimuli impinging upon the total organization, subunit, or member individuals as they try to accomplish their mission.

Nature of the Environment. The environment of an organization can vary along several variables that have some impact on the effectiveness of the organization. The main variables here are: degree of uncertainty in the environment, the general "richness" of the environment with regard to resources needed by the organization, and the responsive nature of the environment (is it benign, hostile, etc.). For example, each unit and subunit in the Navy is surrounded by other organizations and persons, as well as a local geography. These things constitute its environment and must be reckoned with if the unit is to survive and be effective.

Human Resources Availability. The extent to which required human skills and resources are readily available to the organization.

Environmental Strategy. The strategies or procedures that an organization adopts to deal with its outside environment (e.g., Congress, suppliers, radical political groups). These may be: ignore it, monitor it, bribe it, reinforce it, etc.

Human Resources Management. The way in which individuals are selected for the organization and trained and assigned to organizational roles. How "wisely" the organization utilizes people.

Coordination. An individual, group, or set of procedures which integrates parts of the organization toward the objectives of the whole organization. Coordination will be found to some degree whenever 2 or more separate units work simultaneously toward the same objective or sequentially on the same product. For particularly complex organizations, whole units devoted to coordinating other units are sometimes created.

Resource Allocation. The degree to which all available resources are allocated to organizational needs and/or units in ways that contribute toward achieving the organization's goals.

Information Management and Communication. The collection, analysis, and distribution of information critical to organizational effectiveness. Includes the degree to which: mechanisms for ongoing monitoring of pertinent information are established, some method for filtering biases from collected information is used, a regular and efficient channel of distribution of relevant information to concerned organizational members is established, and informal communication lines transmit organizationally valuable information.

Control (Amount of). The total degree of control that exists for influencing and directing the behavior of organization members. Much of the work on this dimension has been with the total amount of control in an organization as well as the distribution of control.

Managerial Interpersonal Skills. The skill and efficiency with which the manager deals with his superiors, subordinates, and peers. The extent to which he gives support, facilitates constructive interaction, and generates enthusiasm for meeting goals and achieving excellent performance. Is meant to include such things as consideration, employee centeredness, LPC, etc.

Managerial Task Skills. The skills a manager, commanding officer, or group leader uses in performing tasks centered on work to be done, and not with the people he manages. This includes: skill in planning of activities, scheduling to avoid lost time, spending little time on crises, coordinating activities with other units or organizations, utilizing staff assistance, and providing resources such as stools, materials, and technical knowledge.

Non Managerial Interpersonal Skills. The degree to which the non managerial staff is open and honest with co-workers, support each other, give feedback, etc.

Table 1
INDEPENDENT VARIABLES (continued)

Quality of Technology. The state of repair, capability of, availability of, and technical adequacy of an organization's technology.

Formalization of Procedures. The extent to which an organization has written or otherwise codified specifications for such things as job duties, responsibilities, promotional paths, authority lines, and communication lines.

Task Goal Clarity. The degree to which organizational task goals are clearly defined and stated (not necessarily understood or accepted) and the degree to which they are congruent with the organzational mission.

Operative Rewards. The specific outcomes which serve as positive or negative incentives and rewards in an organization.

Reward Procedures. The process by which organizational members are rewarded, specifically as it varies on the parameters of selectivity (who gets rewarded), instrumental clarity (the clarity of the basis for reward), and length of feedback loop (between performance and reward).

Participative Decision Making. The degree to which control over the work process and decision making is dispersed through the organization. Participation can vary on a dimension of having an opportunity to contribute to a decision by giving opinions and information, as well as actually having a "vote" on the actual decision.

Organizational Support. The general supportiveness of the organization toward its members, the amount of supportive behavior engaged in by organization members, and the amount of effort by the organization to insure the physical safety and other kinds of protection for its members.

First, the total list is broken into at least a trichotomy consisting of independent variables (or inputs that could be manipulated), dependent variables (or the outcomes that are of real interest and that constitute some sort of payoff), and intervening variables (or the "given" characteristics of organizations that, depending on the degree to which they are present, might make a difference in the way a change in an independent variable affects a dependent variable). For example, should organizational structure be taken as a "given" and viewed as some kind of moderating variable, or is it something that can be manipulated as an independent variable? In organizations with long traditions such as the Navy maybe it must be taken as a given, but maybe not. In general, there are serious and important questions to be asked about which characteristics of organizations are manipulatable "handles," which are the outcomes of real interest upon which the organization's payoff is based, and which act as constraints on, or modifiers of, the intended effects of pulling the handles.

Obviously, the items on the list also vary a great deal in terms of the degree to which they have been operationalized, or have the potential for being operationalized. Not all of them by any means have appeared in empirical studies.

The following section is to characterize the current state of affairs within each of these three major classes.

A Consideration of Dependent Variables

Several things are immediately obvious about the list of dependent variables. First, there are a lot of them and there have been precious few attempts to weed out the overlap and get down to the basics. Second, they vary considerably on a dimension of generality/specificity. Third, they vary on an objective vs. perceptual measurement dimension. Fourth, they vary on a continuum that could be called closeness to the real payoff. For example, is morale the continuum on which the real payoffs are made or is it a means to an end? That is, is morale important because it is related to some more distal variable that is the organization's real concern? This is not precisely the same thing as Thorndike's classic distinctions among immediate, intermediate, and ultimate criteria. Morale may indeed be the desired outcome of real interest and we could consider immediate, intermediate, and ultimate ways of measuring it. Rather, this distinction really points up several other issues. One is that the decision about which of these are means and which are ends is a value judgment on somebody's part. It is made implicitly or explicitly in organizations every day and cannot be avoided. Second, if the decision is that particular variable is a means and not an end, is it necessary to demonstrate empirical relationships between that variable and the outcomes of real interest? Or should those relationships be assumed, since the outcomes of real interest are usually so difficult to specify and measure? It is precisely here that the goal model and natural systems model diverge. Most theorists, researchers, and practitioners who adopt the natural systems point of view appear to accept the basic assumption that the systemic variables contained in their model are significantly related in a causal fashion to accomplishment of a variety of organizational missions. In contrast the goal model demands data.

In the best of all possible worlds it would be nice to have some overall hierarchical map of how the criteria fit together in terms of their generality/specificity and means/end relationships. Perhaps part of this map could be determined empirically but, for reasons that will be discussed later, a good share of it must be specified judgmentally and such judgments be made more reliable, explicit, and valid.

There have been only two systematic attempts that are known to search for the major factors comprising the dependent or criterion variables of organizational effectiveness. One of these was done at the University of Minesota Industrial Relations Center by Mahoney, Weitzel, and others (Mahoney, Frost, Crandall, & Weitzel, 1972; Mahoney & Weitzel, 1969) and the second is the well known effort by Seashore, Yuchtman, and others at the Institute for Social Research (Seashore & Yuchtman, 1967).

The Minnesota study used a questionnaire format to obtain ratings on the effectiveness of 283 departments or subunits sampled from over a dozen different firms. The ratings were made by managers at least one step removed from the direct management of the subunit, and the questionnaires included 114 items gleaned from the literature as being potential indicators of effectiveness. The correlations among the 114 items were factored and 24 effectiveness factors were labeled and defined. They are listed in Table 2.

Table 2

Twenty-four dimensions of organizational effectiveness, derived from a factor analysis of ratings on 114 effectiveness criteria for 283 organizational subunits. Criterion variables were selected from a list of variables studied in organization theory literature, and rationally developed by the authors (from Mahoney & Weitzel, 1969).

Flexibility. Willingly tries out new ideas and suggestions, ready to tackle unusual problems.
Development. Personnel participate in training and development activities; high level of personnel competence and skill.
Cohesion. Lack of complaints and grievances; conflict among cliques within the organization.
Democratic supervision. Subordinate participation in work decisions.
Reliability. Meets objectives without necessity of follow-up and checking.
Selectivity. Doesn't accept marginal employees rejected by other organizations.
Diversity. Wide range of job responsibilities and personnel abilities within the organization.
Delegation. High degree of delegation by supervisors.
Bargaining. Rarely bargains with other organizations for favors and cooperation.
Emphasis on results. Results, output, and performance emphasized, not procedures.
Staffing. Personnel flexibility among assignments; development for promotion from within the organization.
Coordination. Coordinates and schedules activities with other organizations, utilizes staff assistance.
Decentralization. Work and procedural decisions delegated to lowest levels.
Understanding. Organization philosophy, policy, directives understood and accepted by all.
Conflict. Little conflict with other organization units about authority or failure to meet responsibilities.
Personnel planning. Performance not disrupted by personnel absences, turnover, lost time.
Supervisory support. Supervisors support their subordinates.

Table 2 (continued)

Planning. Operations planned and scheduled to avoid lost time; little time spent on minor crises.

Cooperation. Operations scheduled and coordinated with other organizations; rarely fails to meet responsibilities.

Productivity-support-utilization. Efficient performance; mutual support and respect of supervisors and subordinates; utilization of personnel skills and abilities.

Communication. Free flow of work information and communications within the organization.

Turnover. Little turnover from inability to do the job.

Initiation. Initiates improvements in work methods and operations.

Supervisory control. Supervisors in control of progress of work.

Note.-From T. A. Mahoney and W. F. Weitzel, Managerial model of organizational effectiveness. *Administrative Science Quarterly*, 1969, 14, 357-365.

Each subunit was also rated on "overall effectiveness" and a major additional step was to compute a multiple regression equation regressing the 24 factors against the overall rating. The regression analysis was done for different types of subunits, for organizations of different sizes, and for organizations employing different technologies. In general, the factors which account for greatest variance in the overall effectiveness rating are not the same across the various breakdowns of the total sample of subunits. That is, the compositon of overall effectiveness is different for production vs. R & D units, for mass production first unit production, etc.

The effectiveness dimensions identified by the ISR group in a factor analytic study of the performance of 75 insurance agencies are shown in Table 3.

Table 3

Ten dimensions of organizational effectiveness derived from principal component analysis and varimax rotation of scores on 76 performance variables for 75 life insurance agencies. Performance measures were selected from a list of such criteria used by parent company to assess agency effectiveness (from Seashore & Yuchtman, 1967).

Business volume. Expresses different aspects of organization size in respect to manpower and to number and value of policies sold.

Production cost. Efficiency of sales, production process; cost per unit of sales volume.

New member productivity. Productivity of members having less than 5 years tenure with agency.

Table 3 (continued)

Youthfulness of members. Relative frequency and productivity of members under 35 years of age.
Business mix. A combination of three conceptually unrelated performance indices, interpreted as reflecting the ability of agencies to achieve high overall performance through any of several strategies.
Manpower growth. Relative and absolute change in manpower levels.
Devotion to management. Sales commissions earned by agency managers, high commissions are interpreted as reflecting high interest in sales and corresponding low interest in management activities.
Maintenance cost. Efficiency of administration of manpower, plant, and established customer resources.
Member productivity. Average new business volume per agent.
Market penetration. Proportion of potential market that is being exploited.

Note.-From S. E. Seashore and E. Yuchtman, Factorial analysis of organizational performance. *Administrative Science Quarterly*, 1967, 12 377-395.

The basic data for this Michigan study were not questionnaire responses or subjective ratings but consisted of archival records of sales and personnel data. The nature of the business which was studied makes it hard to generalize these results but a number of findings are suggestive. For example, relative to the "devotion of management" factor one could ask how much time a squadron commander spends flying vs. managing.

Based on their own data and related experiences, Seashore (1972) has drawn several negative "morals" concerning effectiveness criteria. To wit:

1. If several raters are asked to rank order a number of organizations or organizational subunits in terms of their overall effectiveness the interrater agreement is usually quite low. Unless they are all of extremely like mind, different raters tend to focus on different facets when making their judgments.

2. In the real world criterion measures sometimes correlate negatively when they aren't supposed to.

3. In the real world so-called hard data or "objective" criterion measures usually turn out to be quite "soft." No one needs to be reminded that in almost all cases any number of artifacts and biases operate to water down the fidelity of objective measures such as profit, costs, turnover or retention rates, number of missions flown, etc. There is no refuge in objectivism.

4. In the real world it is probably a mistake to think of effectiveness criterion variables, regardless of how many there are or at what level they are, in terms of continuous and linear functions. For example, higher and higher retention rates may be "good" up to a point and then become "bad." Notice the perspiration that begins to flow when we ponder the implication of the words good and bad.

In total, Seashore's misgivings brood ill for the shotgun factor analytic approach to objective criteria of organizational effectiveness.

With the exception of these two examples very little systematic work has been done on trying to identify and measure the component criteria of overall effectiveness; and, obviously, there are a number of parameters that serve to circumscribe both the Minnesota and Michigan results. By and large, the remainder of the research studies chose criteria on the basis of availability and made no attempt to study the criteria themselves. It is unfortunately the case that there are many alternative measures of quality, productivity, profitability, turnover, and the like, and we usually have no basis on which to predict how these alternative indices will be related to one another.

As was noted previously, a theorist, researcher, or practitioner in this filed who is not a rigid adherent to the goal model must necessarily have some a priori notions about dependent variables that are important. Sometimes these have been explicitly and formally stated and sometimes they have not. An example of an explicit statement is the set of dimensions measured by ISR's Survey of Organizations questionnaire (Taylor & Bowers, 1972). These variables and their definitions were shown as Table 4.

Table 4

Perceived dimensions of organizational characteristics assessed by the Survey of Organization's questionnaire (Taylor & Bowers, 1972).

1. Climate: perceived total impact upon a work group of the behaviors of superior work groups in terms of:
    a) High or low concern for human resources
    b) Adequacy of communications flow
    c) Nature of motivation to perform
    d) Decision making practices
    e) Technological readiness and flexibility
    f) Amount of lower level influence in departmental decisions

2. Supervisor leadership
    a) Support: behavior that enhances someone else's feeling of personal worth and importance

Table 4 (continued)

   b) Interaction facilitation: behavior that encourages members of the group to develop close, mutually satisfying relationships
   c) Goal emphasis: behavior that stimulates an enthusiasm for meeting the group's goal or achieving excellent performance
   d) Work facilitation: behavior that helps achieve goal attainment by such activities as scheduling, coordinating, planning, and by providing resources such as tools, materials, and technical knowledge

3. Peer leadership

   a) Support
   b) Interaction facilitation
   c) Goal emphasis
   d) Work facilitation

4. Interpersonal processes within work groups

   a) Confidence and trust among members
   b) Strong, shared motivation toward goal attainment
   c) Effective group decision making
   d) Effective, open communication within the group
   e) Mutual help and coordinated activity
   f) Flexibility, adaptability, and creativity
   g) Job competence through skill upgrading

5. Satisfaction with:

   a) Supervisor
   b) Work group
   c) Job
   d) Organization
   e) Pay
   f) Past progress within the organization
   g) Future expected progress within the organization

6. Performance

   a) Volume of work
   b) Efficiency
   c) Product quality
   d) Attendance
   e) Organizational and manpower growth and development
   f) Human costs (e.g., accident rate, health, stress, grievances)

Bennis (1965) has noted that most researchers and practitioners in the behavioral science brand of organization development have very definite ideas about what an effective organization should be like but they are often not explicitly stated. Even though there are many variations in OD techniques, Bennis (1969) has also noted that there is a fair amount of homogeneity in the desired end product.

At the risk of satisfying no one and alienating everyone, the following list is a description of what the behavioral science OD orientation would regard as an effective organization.

1. There are pervasive and shared norms of openness and trust.

2. Interpersonal and intergroup conflict is dealt with openly and without defensiveness.

3. Communication among individuals and groups is frequent, accurate, non defensive, and reflective of whatever emotional component the messages actually possess.

4. Problem solving among individuals or groups utilizes the kinds of interpersonal and communication skills learned in a T-group.

5. The hierarchical and functional relationships among people are a function of their expertise vis-a-vis the task rather than formalized role specifications.

6. To the fullest extent possible, jobs are designed and job assignments are made such that individuals can experience feelings of achievement and self-actualization.

Consideration of such a list illustrates that probably none of these variables are what a goal oriented researcher or practitioner would refer to as an organizational objective. Organizations are created for the purpose of producing certain goods or services or accomplishing certain tasks. Whatever the specific objectives might be, the OD point of view seems to assume that they will be achieved if the organization could successfully develop the "means" listed above.

Intervening Variables

In general, the variables in this list are characteristics which describe the organization as a particular entity. They refer to the structure of the organization and its processes which together distinguish it in form from other organizations. It is these sorts of variables which have been used by a number of people to develop typologies or taxonomies of organizations (e.g., Blau & Scott, 1962; Etzioni, 1961; Hall, 1972; Woodward, 1965).

The variables themselves tend to break down into two major types, according to whether they are measured via the perceptions of the organization members or by more "objective" means such as personnel records, observations of the work process, and the like. Perceptual measures usually, but not always, go under the general label of organization climate. Roy Payne's paper in this same volume makes a somewhat different distinction. Most attempts to measure climate have used a test construction type approach in which a large number of paper and pencil items are amassed and the total pool is intended to sample all the characteristics of an organization that might distinguish it from other organizations in the eyes of its members. That is, the usual intent is to measure characteristics of an organization that are defined and organized in the way the individual's perceptual apparatus organizes them. The components of organizational climate should be the same components that an individual uses when he looks at his organizations and asks, "what kind of a place is this?"

The items are intended to permit the individual to describe, not evaluate, the organization. For example, the individual might be asked to judge the degree of felt pressure to get work done but not evaluate whether there is too much or too little. This is not always an easy distinction to make. Likewise a description of an organization's climate is meant to be something different than an individual's judgment concerning whether he is equitably rewarded, or satisfied, with his job outcomes. Logically at least, there is a difference between saying that most jobs in a particular organization are very autonomous and saying that you yourself are satisfied with the degree of job autonomy which you have. The climate judgment is intended to be much less a function of individual differences than is job satisfaction, and more a function of the organization or subunit of which the individual is a member.

A number of different questionnaire measures of organizational climate now exist (Campbell & Beaty, 1971; Litwin & Stringer, 1966; Schneider & Bartlett, 1968; Taylor & Bowers, 1972) which vary somewhat in length and content but which seem to tap at least the five components subsumed under climate in the list of intervening variables in Table 1. Regarding the nature and usefulness of climate, a great deal of empirical argument is currently going on about how many components there are, whether they are defined the same way for different organizations, whether climate perceptions can really be differentiated from job satisfaction, and whether the differences between observers as a source of variation outweighs the differences between organizations. The answers are not yet in.

Saying that climate is an intervening variable does not help much in specifying how it actually can be used to explain the organization's effectiveness. Unfortunately, the literature provides very little conceptual assistance. Investigators have worried more about how to measure climate rather than about the role it should have in explaining organizational behavior. In spite of this, several empirical studies have yielded promising results. In a large simulation study, Frederiksen et al. (Frederiksen, Jensen, Beaton, & Bloxom, 1972) showed that "consistent" climates yielded higher productivity and that an autonomous unstructured atmosphere permitted individual skills and abilities to play a greater rôle in individual performance. In a rather provocative study, Schneider and Bartlett (1970) compared the climate of insurance agencies as described by the managers and by the agents. There was a substantial correlation between the productivity of the agency and the degree to which the two profiles matched.

On the face of it at least, the way an individual perceives an organization should have a great deal to do with his reward expectations and thus his behavior. It should also have something to do with how an individual perceives the tasks he is to perform (e.g., are they demanding or easy?) and the strategies he selects for accomplishing them (e.g., is it okay to "cheat?").

On the objective side of the Lewinian dichotomy, there also has been considerable activity. A number of researchers, primarily in Great Britain, have been trying to develop measures of the structural and process components that characterize organizations. Perhaps the two major efforts have been those by Joan Woodward (1965) and the group at the University of Aston (e.g., Pugh, Hickson, Hinings, MacDonald, Turner, & Lupton, 1963). They are illustrative of the state of the art pertaining to how structure and process can be measured and the degree to which they can be used to explain organizational functioning.

Both sets of researchers acquired a sample of 40-50 firms (in Great Britain), proceeded to visit each firm, and used interviews, organizational charts, and archival records to collect a great deal of data pertaining to the type of technology employed (e.g., batch, unit, continuous flow), the total organization size, size of various subunits, span of control in various subunits, locus of decision making, and the like. The Aston group has been the more vigorous in trying to develop standardized measures of many of these variables. For example, by factor analytic type procedures they have developed what they hope are measures of the basic components of organizational structure. These factors they derived are given in Table 5.

Table 5

Four factors of organizational structure identified via a factor analysis of non perceptual measures (Pugh et al., 1968, 1969).

Factor	Definition
Structure of Activities	The degree to which the behavior of employees is defined by dividing work into specialist jobs, laying down routines, procedures and formalizing them by insisting on written records, etc.

Table 5 (continued

Concentration of Authority	Degree to which authority to take decisions is concentrated at the top of the organization, or outside the organization, if it is part of a larger company.
Line Control of Workflow	The degree to which control is exercised by line personnel as against its exercise through impersonal procedures.
Relative Size of Supportive Component	The relative number of non-productive personnel i.e. auxiliary support to main workflow.

Although both studies are cross sectional, both Woodward and the Aston group seem to focus on the causal and developmental relationships among technology, size, structure, and management practices. By and large they do not concern themselves with organizational effectiveness or individual effectiveness. They are still at the level of sorting out the internal relationships. For example, one bone of contention is whether organization size determines the technology employed or vice versa. Perhaps the more interesting data are the relationships between management practices and technology. There are some hints in Woodward's data as to what kind of management might be needed as an organization becomes more highly technical and automated. One provocative suggestion here is that to a large extent management practices are predetermined by the technology of the organization. Changing management practices via a selection or training strategy would be that much more difficult. Rather, the emphasis should be on "enhancing" whatever kind of management the technology calls for.

The work of the Aston group has now been extended in several additional studies. Child (1972) attempted a direct replication in a nationwide sample of 82 English firms. Additional extensions have been carried out by Inkson, Schwitter, Pheysey, and Hickson (1970), Hickson, Hinings, McMillan, and Schwitter (1971), and Payne and Mansfield (1972). As noted by Payne and Pugh (in press) the results from these studies pertaining to internal relationships among structural variables seem to exhibit considerable stability and meaningfulness.

However, in total, the research on structure and process variables has not gotten very far toward determining their role in organizational effectiveness and this seems to be true of the intervening type variables in general. To really map out their effects is going to require studying a very large number of interactions which will chew up degrees of freedom, the likes of which we have never seen.

Independent Variables: Which Handle to Grab

This category contains what is probably the bulk of the literature in industrial and organizational psychology and although tempting (sic), we do not wish to recount all of it. One thing that should be pointed out is that most of the research on these various handles has focused on individual behavior or performance as an independent variable. There are very few studies which have used organizational units as degrees of freedom, as for example in comparing various selection strategies or training methods. Again, the work done at Michigan by the ISR group is the most notable exception and the principal handles which Likert, Bowers, and Seashore have grabbed are primarily managerial interpersonal skills, communication methods, and participation in decision making. In their cross sectional studies of package delivery outlets (Georgopoulos & Tannenbaum, 1957) and insurance offices (Bowers & Seashore, 1966) and in the longitudinal case study at Harwood Industries (Marrow, Bowers, & Seashore, 1967), these variables have tentatively been shown to have generally positive relationships with various measures of organizational effectiveness.

Beyond this there is not a great deal of organizational research that can be differentiated from individual research which is too bad since many of these variables have been shown to be related to individual performance. The people who call themselves OD practitioners do indeed manipulate some of these variables in hopes of producing changes on some organizational dependent variables but they tend to collect very little research data. The exceptions to this generalization are a relatively small number of data based studies such as that done by Blake, Mouton, Barnes, and Greiner (1964).

One thing that might be useful is to look at the list of independent variables with an eye towards the kinds of mechanisms by which they might exercise their effects. A list of such mechanisms might appear something as follows.

1. The aim could be to influence a unit or organization's choice of tasks or problems on which to work and the degree of effort expended once the choice is made. This is a so-called "motivational" consideration and involves task choice and task effort.

2. The aim might be to increase an organization's understanding of the task to be performed or problem to be solved.

3. Another possible mechanism is to increase the organization's basic underlying aptitudes (e.g, select more competent people) for the task involved.

4. Another is to increase its specific task skills through some kind of training.

5. Finally, a change in equipment or technology for the task might be a way to increase organizational effectiveness.

It might be of interest to juxtapose this basic set of mechanisms against a simple listing of all the different methods that have been used to change organizational effectiveness, at least to some degree. This list appears as Table 6 and is everything we could think of, based on the current literature review plus others we have done.

Table 6

Partial listing of possible methods for changing the effectiveness of organizations.

- Personnel selection
- Personnel classification
- Career assessment and career planning
- Individual training
  - Orientation training
  - Skills training
  - Managerial and leadership training
  - Human relations training
  - Training to enhance nAch
- Individual counseling
- Changes in promotional criteria
- Incentive, or contingent, pay
- Cafeteria pay plans
- Scanlon plan
- Behavior modification
- Flexible scheduling
- Job enlargement
- Job enrichment
- Participation in decision making
- Organization development methods (behavioral science based)
  - Survey-feedback
  - Interview-feedback
  - Problem solving meetings (temporary task forces)
  - Laboratory training
  - Confrontation
  - Process observation and feedback
  - Managerial grid
  - Team development
  - Intergroup laboratory
- Management by objectives
- Changes in organizational structure
  - Changes in functional arrangements (e.g., definitions of task responsibilities)
  - Changes in managerial controls (e.g., human resources accounting)
  - Matrix management

Table 6 (continued)

- Changes in organizational processes
    - Management information systems
    - Operations research and analysis
    - Communication practices
    - Manpower planning techniques
- Advances in technology

Considering such a juxtaposition of underlying mechanisms against specific techniques poses some interesting questions about how various independent variables work. For example, does participation work because it influences choice and effort (motivation input) or because it leads to better utilization of information (a cognitive input)?

The moral here is that the more we understand about the processes involved the better off we are. However, organizational researchers have not often looked inside the black box. There is a wealth of data on correlating these various independent variables with selected dependent variables but the processes involved are seldom examined systematically. It would be to our advantage to do so.

Some Conclusions and Implications

Based on this look at the "state of the art" concerning organizational effectiveness, the summary comments are as follows:

1. Mapping out the empirical relationships among some set of independent, intervening, and dependent variables with the aim of an overall understanding of how organizations work is a futile undertaking. It is impossible at this time to acquire the necessary degrees of freedom to investigate very many interactive relationships or even to pursue multivariate analyses of any complexity. It most likely is not possible to use empirical multivariate techniques to investigate the dimensionality of organizational effectiveness. Somehow the mess created by accepting the fact that organizations are complex must be bypassed.

2. Generally speaking, the notion of overall organizational effectiveness cannot be given a substantive definition. It simply has too many parts that lose their meaning when they are added together. It is possible of course to ask observers to rank order organization on one continuum without asking them to specify the nature of the continuum, but the degree of agreement will vary depending on the degree to which observers are focusing on the same facets in the same way, and if these dynamics aren't examined, the state of knowledge will not have advanced very far.

3. A disclaimer one often hears about whether a particular relationship between an independent and dependent variable will be observed is that it "depends on the situation," meaning that organizations are

different and what might be true in one will not be true in another. As a response, a number of people have offered up taxonomies of organizations which supposedly outline the basic differences that must be taken into account. In terms of advancing our understanding of organizational effectiveness, this too has been a futile undertaking. Other kinds of intervening variable research are still in their infancy.

4. A neglected area of research has been the effects on the organization of significant changes in the kinds of people that are entering it. The entire domain of organizational effectiveness research and organizational change has a very environmentalist point of view. This is an unfortunate state of affairs for organizations which are about to undergo massive changes in the way they recruit and select new members.

5. The most fruitful research has not been that which tries to conceptualize sampling error and use the organization as a degree of freedom in the same way we do for individuals. Rather, an idealized picture of what appears to be more useful research would be something like the following:

- Drop back to individuals or work groups as degrees of freedom.
- Focus on dependent variables that you are willing to assume have an important link to overall organizational functioning.
- Include as part of the research program a systematic look at the process involved. That is, instead of demonstrating only that a program of job enrichment resulted in high retention rates for skilled personnel, get inside the organization and try to find out precisely how the various elements of the job enrichment program affected the people involved. If the dynamics could be illuminated you should be in a much better position to predict whether a particular relationship will generalize. In general, we think it would be much more fruitful to identify the process parameters in a particular independent variable-dependent variable relationship and then see whether these are present in some other organization than it is to build a taxonomy of organizations and then decide if these organizational parameters have anything to do with whether a particular independent variable will work.

Suggestions for the 1980's

A. Since it is probably futile to attempt to specify directly the goals of various types of Naval organizations and proceed through multivariate criterion development, the following tentative suggestions for attempting first of all to understand the dependent variable side are available. Since dependent variables (i.e., effectiveness criteria) are used in the end to make decisions, it would be fruitful to look at effectiveness criteria in a decision making framework and from a process point of view. After understanding this process, it should lead to better measurement of criteria and better decision making. Consequently, the following kinds of studies would be helpful.

- A thorough analysis should be made of how the decision makers or power centers in a variety of Naval organizations use the current measures of criteria, whatever they might be. That is, what kinds of decisions are actually made on the basis of existing effectiveness data? Case studies of actual decisions could be carried out and policy recapturing techniques could be applied to both real and simulated decision situations. Concomitantly, decision makers could be asked about the kinds of information they wished they had. This should give a better idea of what the powers that be want measures of organizational effectiveness to be good for.

- Since it doesn't seem like a good idea to commit R & D resources to a large scale study of many organizational units using a multivariate approach, it might be wise at some point to identify a few organizations or subunits that everyone agrees are effective and a few which everyone agrees are ineffective and conduct intensive case studies of each, looking for similarities and differences on variables like those in Table 1. Glaser and Taylor (1973) used such a technique to diagnose what makes an R & D organization effective and it appeared to be a valuable effort.

- Regardless of whether a goal or systems model is adopted, it is a truism that the organization operates on goals of some sort, even if they cannot be verbalized and are fragmented across subunits or organizational decision makers. There are indirect techniques for articulating these goals and it would be worthwhile to train people in Naval organizations to use them to determine the types of goals on which they operate. More importantly it would also have the effect of revealing to the relevant decision makers more of the processes by which they operate. In the end, the procedure to be taught might have some or all of the following ingredients.

  A critical incident procedure could be used in which various subgroups in an organization would be asked to describe specific examples of effective and ineffective organizational performance. Commanding officers could do it, non-commissioned officers could do it, enlisted men could do it. The descriptions obtained from each group could be submitted to a qualitative cluster analysis by various groups of judges to infer the operative goals that seem to be represented.

A second skill would be the ability to collect observations of actual decision makers' behavior. These observations could also be submitted to a qualitative dimensional analysis. The overall question is whether the goals of the organization can be inferred from the way the powers that be reacted to problems, requests, and other stimuli.

In sum, it would be valuable if a research effort could develop some relatively efficient techniques that Naval organizations could use themselves to self-diagnose their operative goals. That is, by means of critical incident and policy recapturing techniques, assisted perhaps by a bit of process consultation (ala Ed Schein) it should be possible to determine what operating goals are being used and how they are being used and make this information a regular item of feedback.

B. Since it may indeed be extremely difficult to specify all the demands that are made on an organization (since some of the most important occur only rarely) and develop straightforward standardized criteria for how well these demands are being met, it is felt that it would be effort well spent to concentrate instead on developing standardized measures of so-called system integrity. That is, some method will have to be used to elicit from the relevant parties, a judgment as to the components that make up an effective system and then develop criteria measures for these components. The paper by Professor Milkovich explores this issue further.

C. Looking over the laundry lists of independent variables one can see a number of handles that have shown to be promising in other organizations and on which the Navy could begin its own developmental work. The areas we would consider to be the most promising are:

- The question of whether or not individuals understand their own task goals and whether goals are stated in specific concrete terms. Both the work on Management by Objectives and by Ed Locke in the laboratory strongly suggest that "knowing what to do" is a powerful determinant of behavior.

- If various jobs in the Navy can be carefully described and the description used in recruiting to create a very accurate picture of what the individuals can expect (instead of over or under selling) will it result in new personnel who are more "committed" to the Navy, have higher retention rates, and perform satisfactorily? That is, can self-selection improve upon organizational selection?

- In either the private or public sector, there have been very few in-depth studies of what outcomes individuals actually seek from a job. Studies of job satisfaction most often sample their item content from almost everywhere except the job incumbents themselves. It would profit the Navy to do such a study from the ground up and not immediately jump to a questionnaire study which imposes a structure on the respondents.

FOOTNOTES

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MODELING, MEASURING AND MONITORING ORGANIZATIONAL EFFECTIVENESS

George T. Milkovich

The content of this paper is based upon a review of the literature related to the feasibility and desirability of developing a personnel status index. (Dunnette, Milkovich, Motowidlo, 1973). The review highlights the potential overlap in

- the meaning of organizational effectiveness concepts found in several different fields of study
- the approaches to measuring these unit effectiveness concepts in various disciplines
- the uses that are proposed for monitoring unit effectiveness

The Meaning of Organizational Effectiveness

Organizational effectiveness as a concept is found in the literature of several fields. Organization theorists in sociology and psychology discuss and attempt to measure it. Military managers have long considered a similar notion, readiness; economists and the human resource value literature discuss a concept called value; and macro-sociologists and economists are currently developing social indicators of various governmental and public units such as the quality of life and education.

The socio-psychological literature does not contain a universally accepted meaning of effectiveness of organizational units. (Katz and Kahn, 1966; Mahoney, 1967; Price, 1968; Ghorpade, 1971). It is generally defined as an organizational unit's goal accomplishment. The literature, however, generally distinguishes between a rational-goalistic and a systemic model or organizational effectiveness.

The goalistic model defines effectiveness by comparing organizational goals to actual outcomes. This definition focuses the measurement of effectiveness upon identifying the units' goals and actual outcomes. The literature suggests no single set of organizational goals but instead a hierarchy of goals similar to Thorndike's (1949) hierarchy of performance criteria: ultimate, intermediate and immediate goals (Georgopoulos and Tannenbaum, 1957; Mahoney and Weitzel, 1969). Seashore and Yuchtman (1967) for example, state that certain aspects of organizational effectiveness (such as production costs) carry the burden of short-term demands in order to sustain the longer run potential (such as share of the market). The mid-range goals (intermediate and immediate) tend to be the ones, however, that policy makers typically use in assessing unit effectiveness (turnover, productivity, billet vacancies).

The systemic model defines effectiveness as the state of the internal processes by which resources (inputs) are procured from the environment and outcomes are produced. An effective organization is one that is adaptive enough to procure resources and provide outcomes in such a manner as to remain in equilibrium. An effective unit is a robust and adaptive one. (Etzioni, 1960; Seashore and Yuchtman, 1967).

Military managers have also developed a concept of organizational units effectiveness. Hayward (1968) defines effectiveness (military-army combat) in terms of three variables; the unit's capabilities, human and material resources; the environment, weather, terrain, and vegetation; and the nature of the mission, the territory to be gained or held, within some time constraint, at a maximum allowable cost. Combat effectiveness of a unit is a function of the probability of success in combat, the capability of a friendly force, the capability of an enemy force, the environment, and the mission.

Another similar concept used by the military is readiness. Naval readiness was widely discussed and studied in the 1960's. Several task force and consultant reports dealt with the problems associated with the concept's meaning, measurement, and reporting systems (Popper and Miller, 1965). An attempt to "unify the language of readiness" provided the following definitions:

- Readiness - Predicted ability to accomplish those missions for which the unit is equipped and manned, or which have been assigned for accomplishment. Readiness is the summation of performance, endurance, and preparedness.

- Combat Readiness - Readiness to accomplish missions involving physical combat.

- Readiness for Non-Combat Missions - Readiness for accomplishment of missions not necessarily involving physical combat.

- Operational Readiness - The summation of Combat Readiness and Readiness for Non-Combat missions.

- Capability - Collective term denoting the design characteristics of available equipment or specifically equipped units. Equipment capability should not be described by the use of qualitative adjectives, such as "high", "low", "unsatisfactory", "excellent", etc., without indication of the standards of comparison.

A 1965 survey of the Navy's readiness reporting systems found five principal components of overall Naval operational readiness: material, personnel, training, endurance, assignment and location. (Management Research and Consulting Division, Clark, Cooper, Field, and Wohl, Inc., 1965). The survey was part of research to develop the METRI (Military Essentiality Through Readiness Indices) systems for improved allocation procedures or policies for material resources. Based upon the above discussion, a "ready unit" is one that accomplishes the goals for which it has been equipped and manned; similarly, an "effective unit" is one that accomplishes its goals and/or adapts and maintains itself.

The Navy ought to consider what differences, if any, exist between its concept of readiness in which a considerable expenditure has already been made and the organization theorists' concept of effectiveness. A distinction may lie in that readiness is more goalistic, results oriented, while effectiveness can also be described in more health, status or process oriented terms.

In addition to organization theorists and military planners, other fields have concepts similar to organizational effectiveness. Applied economists, using the country as an organizational unit, assess the state or effectiveness of the country's economic activities through several indicators. For example, current employment conditions are reflected by employment levels, unemployment and participation rates, job vacancies, and labor turnover. Prices and cost of living conditions indices are generated, as are wage rate, productivity rates, accident and work stoppage rates.

These data are collected via survey and legally required reports. The indices' shortcomings and limitations have been well documented. (president's Committee to Appraise Employment and Unemployment Statistics, 1962, Wolfbein, S. L., 1964). Changes in these and other economic indices are used to describe the state or "health" of the economy and to evaluate the effectiveness of various monetary and fiscal programs.

Probably the best known present day economic index of the country's effectiveness is the GNP. The GNP is the exchange value (price) of the newly produced goods and services that are not resold in any form during the period under study. Published by the Commerce Department, the GNP is a measure of the flow of final output resulting from the economic activity of the U.S. during a selected period at current prices. The GNP has well-recognized limitations and shortcomings. Macro-economists are currently grappling with the notion of the GNP's "construct validity" as an index of the effectiveness of country economic growth. Modern economic thought is advocating adjusting the GNP measure to achieve a more meaningful measure of value which is called net economic welfare (NEW). (Morgenstern, 1963). The NEW measure attempts to account for factors omitted in GNP, such as the damage caused to the environment by generating additional kilowatt hours of power and the value of a homemaker's services in the household.

The human resource value (HRV) literature was reviewed as part of the project pertaining to the desirability and feasibility of developing a personnel status index. The HRV literature discusses the assessment of people as organization resources. (Flamholtz, 1971, 1972; Likert and Bowers, 1969). An individual's value to an organization is the present worth of the set of future services that individual is expected to provide during the period he is anticipated to be with the organization (Flamholtz, 1972). While the literature does not directly include the assessment of organizational unit activity, a unit's value to some larger organization may be considered as the present worth of a future stream of services that the unit is expected to provide during the period under consideration.

A final example of the interdisciplinary nature of organizational effectiveness concepts can be found in macro-socio-economic literature's current interest in social indicators. (Cartter, 1966; Baur, 1966; Management Science, 1973).

A social indicator is defined as an aggregate welfare measure, a statistic that measures the extent to which some goal of general interest has been achieved (Wilson, 1970). The following quotation highlights the need for indicators of the status of such phenomena as the quality of life and the quality of education.

> "For many of the important topics on which the public administrators and decision makers blithely pass judgment and on which policies are made, there are no yardsticks by which to know if things are getting better or worse". (Baur, 1966)

Quality, like organization effectiveness, in an operational sense, is someone's subjective assessment; in essence, an attribute of value. Quality of life, quality of education, and other social indicators have considerable potential to aid decision makers in such activities as evaluation policies, auditing programs, monitoring trends, and aiding individuals in personal decisions.

These brief illustrations from the literature of diverse, yet related fields of study, reveal the overlap in the meaning of organizational unit effectiveness. Those interested in understanding, analyzing, and explaining organizational effectiveness by necessity should consider an inter-disciplinary view. A universally accepted model of organizational effectiveness cannot be found in the literature. Any organization must decide just what it is attempting to model. Is the phenomenon unit accomplishment, likelihood of accomplishment, or status or health of internal processes? A related question the Navy must answer is one that was raised earlier; how, if at all, does unit effectiveness differ from the unit readiness indices now being monitored?

The Measuring of Organization Effectiveness

The procedures for constructing any indicator of unit effectiveness, be it in economics, psychology or sociology, can be abstracted to a point where several common issues emerge:

- selecting elements to include
- measuring these elements

- establishing weights for the elements
- determining the units to assess
- monitoring, data collection
- assessing the usefulness or validity of the index

This section briefly discusses some of these issues and illustrates some of the unit effectiveness indices that have been developed.

The literature reviewed for this paper suggests that selecting elements to be included in the unit effectiveness measure is done by either prescribing the elements or by eliciting the implicit elements of the current decision makers models. For example, Georgopoulos and Tannenbaum (1957) in a study of the unit effectiveness of 32 retail service units prescribed unit effectiveness to be a function of productivity/flexibility or successful adaptation to externally induced changes, and absence of intraorganizational strain or conflict between organizational subgroups. Hayward (1968) also prescribed military unit effectiveness to be some function of performance, endurance and preparedness.

The current state of knowledge is not advanced to the level where the elements of unit effectiveness can confidently be prescribed. Instead, model eliciting methods that capture the implicit models of decision makers can be used. Whenever budgets are generated, projects and tasks assigned and resources allocated, managers make judgments (explicitly or implicitly) about the relative effectiveness of subordinate units. Managers and officers are themselves sources of elements making up organization effectiveness.

There are several examples of model-eliciting in the unit effectiveness literature. Mahoney and Weitzel (1969) in their studies of organizational effectiveness generated 114 elements of effectiveness culled from the literature and discussions with managers. Descriptions of 283 units on the 114 elements from 84 managers in 13 firms were obtained. The managers perceptions of the degree that each element was descriptive of a subordinate unit were factor analyzed to identify the basic dimensions of effectiveness. Their approach is essentially capturing the elements used by managers in describing effective units. In contrast, Seashore and Yuchtman (1967) factor analyzed a set of actual performance indices (compared with Mahoney et. al's use of managerial perceptions) of 75 sales agencies in one insurance firm over a 10-year period. Ten dimensions of effectiveness were found.

There are other approaches for eliciting models used by managers. Critical incidents gleaned from Naval managers who recall essential differences between effective and ineffective units could be used. The delphi procedure which systematically uses expert judgment to develop an answer to some question could also be considered. (Dalkey, 1967; Milkovich, 1972).

> The delphi has been used extensively in forecasting, e.g., the structure of fringe benefits in the year 2000 or the combination of nuclear devices it would take to reduce an adversary's industrial capacity to 1/3. The delphi panel comprised of Naval decision makers could be asked to judge the effectiveness of a set of Naval units. The information bits these experts requested to make their decision should reflect the items upon which effectiveness judgments are made and in this way elicit the decision elements of the managers.

The elements included in social indicators of unit effectiveness, such as the quality of life among the states or the quality of universities graduate education were drawn from expert judgment. The goals of national quality-of-life generated in the Report of the President's Commission on National Goals were selected as the key elements for the quality of life index.

In sum, the elements to be included in any indicator of unit effectiveness can be prescribed from the current state of knowledge or elicited from decision makers. Considering the current level of knowledge and the potential increase in acceptability, it appears that the Naval officers and managers should be the primary source for the elements of the index.

My review of the literature shows that the measurement of these elements depends upon the variable being measured and the discipline of those doing the measuring. At the risk of over simplification, it seems that economists, accountants and management scientists tend to be overly concerned with administrative feasibility and costs of measurement, while the behavioralist tends to forsake the business at hand, i.e., to develop an index of unit effectiveness for lengthy discussion of reliabilities and validities of their measures.

Hayward (1968) in his article on military unit effectiveness measurement suggests 3 basic approaches to operationalizing variables. Measurement can be based upon actual samples of performance and behavior of the units under real or simulated situations such as war games; upon signs or proxies of effectiveness such as the authorized billet strength minus the actual billet strength of a unit or the level of training received; and upon intuitive judgment. The latter method is most commonly used by managers. Several methods of systematically eliciting judgments have already been discussed. Obviously, the only way to truly measure effectiveness of an organization of any kind is through the analysis of data on its performance under actual operating conditions.

A few illustrations of how some of the unit effectiveness concepts have been measured may be helpful.

METRI: (Popper & Miller, 1965)

A unit personnel readiness index was proposed to the Navy in 1965. The Military Essentiality Through Readiness Indices (METRI) personnel system generated a measure on a zero-to-one scale for the capability of a unit to meet requirements of some assigned missions for a given period.

The basic model of the METRI is simply:

$$R_t + K_1R_1 + K_2R_2 + \ldots\ldots + K_nR_n$$

where

R_t = "TEAM" or unit personnel readiness

K_i = the estimated value of a fully qualified ("ready") team member

R_i = the estimated readiness of a team member to perform assigned duties

The key concept of the METRI method for determining personnel readiness is to compare the actual human resources in terms of the numbers and skill rating to some desired (as authorized by Naval Manpower Authorization NAVPERS-576) state.

$\underline{R_i}$. The basic instrument for measuring personnel readiness is a "readiness matrix"--shown in the figure on the next page. The matrix simply compares the actual to authorized level of personnel. The cell entries are the degree of readiness (on a zero to one scale) an individual possesses to fulfill the functions requirements. For example, if a given job for which SCPO (Senior Petty Officer) is required (according to NAVPERS-576) is actually performed by a POI (Pretty Officer I), personnel readiness is .85. If a POI is required, but an SCPO actually performs the function, then readiness is .95. The procedures for determining the cell entries, readiness, are not discussed in any detail--"this was designed with the aid of personnel in BuPers on a judgmental basis" (Proper and Miller, 1965).

$\underline{K_i}$. The weighting factor K_i denotes the relative importance of each member of the unit to the accomplishment of the unit's missions. For example, a Chief may be assigned a weight of .11 while a Boilerman Third Class may receive a .04. The total sum of "a unit's 'K Factor'" should add up to 1.00. The factors were derived on a judgmental basis from conversations with Navy operating personnel (Popper and Miller, 1965).

The values in the readiness matrix are estimates expressing the amount of readiness lost due to allocations below authorized levels. This assumes authorized levels are the optimal staff level. It also assumes that all the relevant variables related to personnel readiness can be represented in the three elements of this model: the numbers and ratings of personnel and their "K values" of relative contribution to their unit's missions.

READINESS MATRIX

COMMISSIONED OFFICERS

	ALLOWED				
ACTUAL	CDR	LCDR	LT	LTJG	ENS
CDR	1.00	.99	.95	—	—
LCDR	.95	1.00	.99	.95	—
LT	.85	.95	1.00	.99	.95
LTJG	—	.85	.95	1.00	.99
ENS	—	—	.85	.95	1.00

ENLISTED MEN

	ALLOWED								
ACTUAL	SCPO	CPO	PO1	PO2	PO3	*SN	SN	*SA	SA
SCPO	1.00	.99	.95	.90	—	—	—	—	—
CPO	.95	1.00	.99	.95	.90	—	—	—	—
PO1	.85	.95	1.00	.99	.95	.90	—	—	—
PO2	.70	.85	.95	1.00	.99	.95	.90	—	—
PO3	—	.70	.85	.95	1.00	.99	.95	.90	—
*SN	—	—	.70	.85	.95	1.00	.99	.95	.90
SN	—	—	—	.70	.85	.95	1.00	.99	.95
*SA	—	—	—	—	.70	.85	.95	1.00	.99
SA	—	—	—	—	—	.70	.85	.95	1.00

* STRIKER

Organizational Effectiveness

Mahoney and Weitzel (1972) have developed a questionnaire based on their studies of managers' perceptions of organizational effectiveness discussed earlier.

Each organization unit is described on the nineteen factors derived from their earlier work. Each of these factors is in turn made up of 2 or 3 items (58 in all). For example, the factor, Results Emphasis is assessed by the following items:

Short-term results are emphasized in the unit
Rarely 1 9 Usually

Supervisors are more concerned with what is accomplished than methods used
Always 9 1 Never

Supervisory emphasis give to prediction as a goal

The manager is then asked to rate the overall effectiveness of the unit relative to all other units he may have known.

Social Indicators

These are several examples of social indicator measurement. (Cartter, 1966; Wilson, 1970; Management Science, 1973). The quality of life indicators developed by the Midwest Research Institute illustrates the general nature of the measurement. (Wilson, 1970). The quality of life studies profiles each unit (states in this case) on the following nine factors:

- Individual status - Enhancing personal dignity, promoting maximum development of capabilities, and widening the opportunities of individual choice.
- Individual equality - Eliminating discrimination on the basis of race.
- State and local government - Developing an informed and involved citizenry, improving the quality of public administration, increasing collaboration and the sharing of power among all levels of government, and improving the professionalism of state legislatures.
- Education - Improving the quantity and quality of education.
- Economic growth - Increasing both the quantity and quality of growth, including capital investment in the public sector, improving the standard of living, and providing education for a more capable and flexible work force.

- Technological change - Increasing the effort in research and the availability of manpower and facilities to maintain economic growth and improve living conditions.

- Agriculture - Improving the quality of life in the agricultural sector of our economy.

- Living conditions - Alleviating general poverty and the decayed conditions of the cities.

- Health and welfare - Improving the levels of welfare assistance, vocational rehabilitation, and provision of medical services in both the public and private sectors of the economy.

A definition of one of the factors, Individual Equality, developed as part of quality of life studies, illustrates the types of measures used. Individual Equality was defined as three variables of current economic status, current economic discrimination, and socio-economic impairment discrimination. The model takes the following form:

$$1 = a_1X_1 + b_2X_2 = c_3X_3$$

Socio-Economic Indicator for Individual Equality

X_1: Current Economic Status

x_{11}: ratio of nonwhite to white per capita median income adjusted for urban-rural differences in population distribution.

x_{12}: ratio of nonwhite to white employment rates.

X_2: Current Economic Discrimination

x_{21}: ratio of nonwhite to white income adjusted for occupational differences.

x_{22}: ratio of nonwhite to white income adjusted for educational differences.

X_3: Socio-Economic Impairment Discrimination

education

x_{31}: educational attainment as measured by the ratio of the white to nonwhite high school dropout rate.

^{x}32: educational attainment as measured by the ratio of nonwhite to white college graduate rate.

^{x}33: educational quality as measured by the ratio of white to nonwhite percent of draftees who failed the mental requirements portion of their pre-induction examination.

health

^{x}41: ratio of white to nonwhite age adjusted mortality rates.

environmental conditions

^{x}51: urban housing density as measured by the ratio of white to nonwhite percent of occupied urban housing units which are sound and have all plumbing facilities.

^{x}52: quality of urban housing as measured by the raito of white to nonwhite percent of occupied urban housing units which are sound and have all plumbing facilities.

^{x}53: segregation of urban housing as measured by a weighted index of the extent of segregation by census block.

The investigators provided a brief discussion of alternative meaning to individual equality and settled on a definition consistent with the data which are available for analysis. Note also, an independent criterion measure of equality was not considered.

There are several other issues related to the development of an indicator of organizational effectiveness. Should a single composite index or a profile made up of several characteristics be generated? A profile, it has been argued, has greater diagnostic power. On the other hand, single indices seem to enjoy greater acceptability and visibility. The issue is essentially one of devising a procedure for establishing importance weights for the elements to allow them to be combined. A related illustration of this issue of single vs. multiple indicators can be taken from the work on social indicators. Minnesota dropped in rank of overall quality of life from 2nd in 1972 to 13th in 1973. Once the drop was announced, the immediate question from government officials (especially tourism interests) was why. The cause of this drop was a change in the proportion of corporate to family farms in

Minnesota and the fact that the index developers had simply averaged the scores on all the factors to provide the popular press with some figures. The developers later back-tracked and pointed out the inherent weakness in the overall ranking generated by combining such diverse factors that were themselves composites of diverse factors.

Another issue related to the development of a unit effectiveness measure is exactly what units should be assessed? At what levels of organizational functioning should an effectiveness index be calculated: work teams, ships, several ships? Other areas of study have based these decisions upon two criteria: the availability of comparable data and meaningfulness of the unit for the indexes' potential uses.

A final issue is the validation of an index of unit effectiveness. Validation of any measure involves testing and elaborating it. The index would be validated like anything else; i.e., by exploring the logical network of relations that such an index should exhibit and then see to what extent these expectations are realized. Bond (1973) suggests such strategies as having senior command people nominate the best ship and shore units and see if the units have high effectiveness scores or comparing unit operational exercise performance ratings to effectiveness scores. Validation is a long term, interative process, with several attempted uses, elaborations and modifications. From the research--management stance, the validation effort is an attempt to explicate the meaning of the index, to provide some evidence of its stability, logical consistency and practical usefulness. (Dunnette, 1966).

Conclusion

In summary, a wide range of measures is being developed for concepts very similar in meaning and potential uses, to organizational effectiveness. Measures based upon human judgment range all the way from asking persons to describe their organizational environment, to assessing how well a task has been performed, to requiring estimates of the amount of "readiness loss" that is contingent upon understaffing a unit. Compared to assessing the "quality of life" in the various states, the task of developing a reasonable index of organizational effectiveness seems very possible.

There are several meaning, measuring and monitoring issues related to the development of such an index. They need to be resolved. Effectiveness, readiness, status, value, quality, may all reflect an interdisciplinary interest in the "health" of an organizational unit, be it a state, the country, a ship or a work team.

The spurt of interest in organizational effectiveness in the 60's has not yet resulted in the formulation of a universally acceptable methodology for assessing organizational effectiveness. Several potentially useful approaches have been discussed in this presentation. Pilot studies of several of these approaches could be considered. Finally, any research in this area ought have as one objective, the insurance that any effectiveness indices that are proposed be administratively feasible. Another elegant, elaborate mechanism, that few understand will get subverted by the eventual uses.

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SOCIAL-PSYCHOLOGICAL INDICATORS OF ORGANIZATIONAL EFFECTIVENESS

Jerome L. Franklin

One principal reason for focusing upon indicators of organizational effectiveness, whether they are of a social-psychological nature or not, is to enhance the possibility of increasing the effectiveness of organizational functioning. Especially useful is information which can be compared with normative and/or ideal states to indicate areas in which there exist strengths and weaknesses. Such evaluations can result in detailed pictures of organizational functioning which will be useful for improving the organization through a matching of ineffective organizational conditions with appropriate corrective activities. This information has potential value in any organization but can be of special interest and value to organizations faced with major change initiated from within or imposed from without. An example of the latter for the Navy is the change in national policy from a system of military conscription to the all-volunteer forces concept. Such changes create relatively high levels of need for information about the changing effectiveness of organizational functioning.

Inadequacies of Available Indicators

Almost all organizations regularly gather information which is thought to relate to organizational effectiveness. Traditionally, this information has focused upon organizational outputs in terms of volume, efficiency, quality. A number of other indicators are also often considered by organizations because of their assumed relationship to such output measures. Examples of these indicators include satisfaction, absence rates, accident rates, total variable expenses, greivance rates, and more recently, a variety of indicators of individual physical health. Although of some interest, these measures are not particularly useful for suggesting appropriate actions for correcting problems resulting in ineffective organizational functioning. Several reasons account for this:

- The information is often gathered for purposes which promote distortion and inconsistency in computation methods. Meaningful comparisons are difficult to obtain when computation practices change to respond to external (taxes, stock holders) and internal (reward decisions) pressures.

- The information seldom indicates those weaknesses which can be corrected directly. Rather, the information provides an indication of the result of a multitude of behaviors and conditions which have interacted to transform organizational inputs into the measured outputs. Like body temperature, the information may indicate the existence of a problem in the system but will not help locate the site of the problem. In large organizations like the Navy, the system is quite complex and the causes and locations of alterable conditions may be extremely difficult to identify.

- The information typically available in organizations presents indications of effectiveness late in what is often a long and complex sequence of events. Thus, even if this information could serve as the basis for taking corrective actions in early elements of the sequence, the damage has, in a sense, already been done once the situation becomes evident through these indicators.

Thus, a general problem faced in many organizations attempting to improve organizational effectiveness is that there is a lack of information useful for making meaningful corrective decisions. When available, the information is often inaccurate, unstandardized, and provides little insight into basic alterable conditions and the manner by which they relate to organizational outputs. Faced with only this type of information one is left without a manner by which action can be taken to improve organizational functioning through the systematic identification and correction of weaknesses in organizations.

Advantages of Social-Psychological Indicators

Partially, in an attempt to gather more useful information for the purpose of systematically improving organizational functioning, there has been an increasing interest upon social-psychological aspects of organizations. Among these are such aspects as leadership, decision-making practices, influence patterns, motivational conditions, and communication patterns. An important reason for focusing upon these variables is that they are thought to be causally prior to organizational output variables. That is, they effect many of the criteria judged to be important indicators of organizational effectiveness or success.

Models of Organizational Functioning

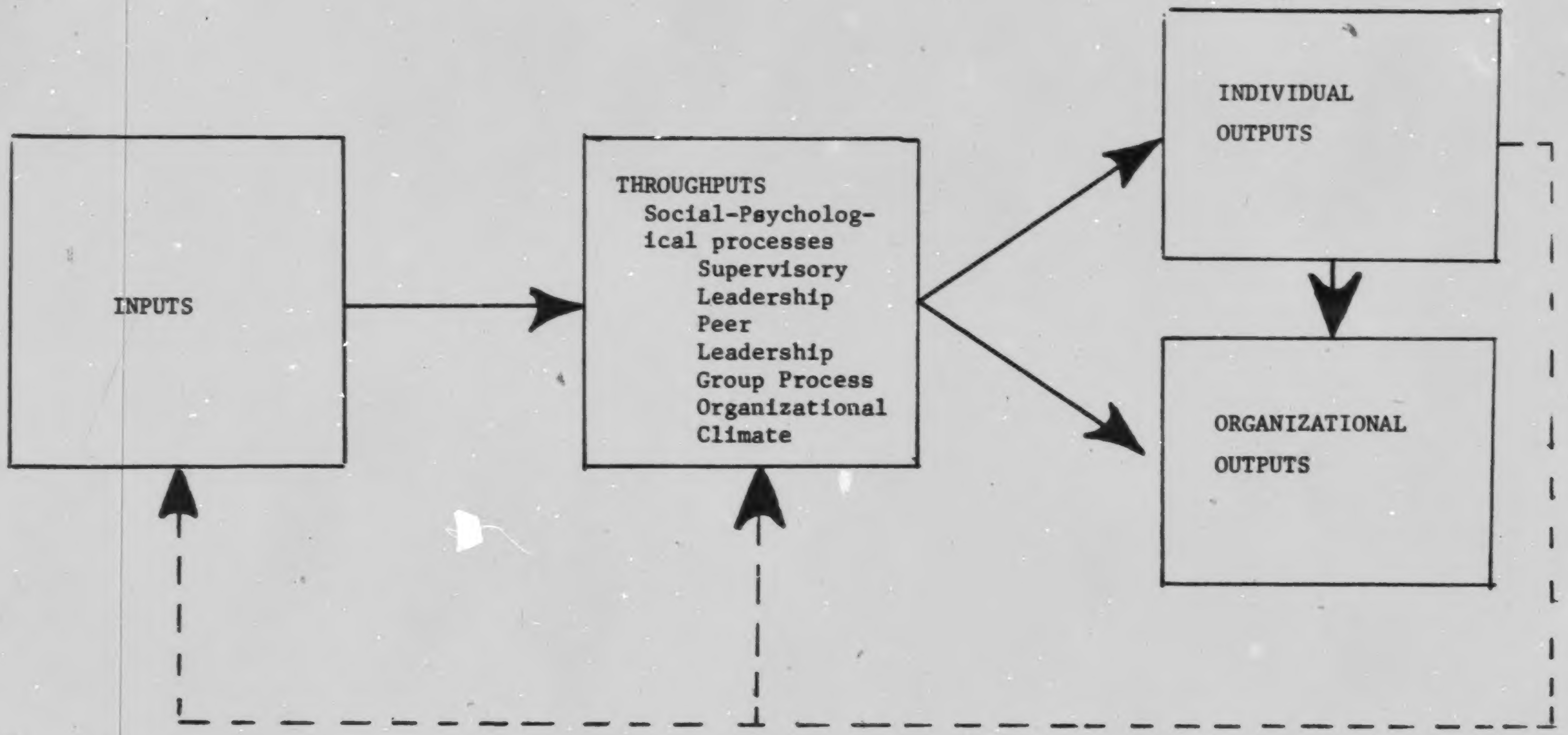
As the above statements suggest, models of organizational functioning have been developed which identify and causally relate major social-psychological factors to one another and to other factors. Although these models are not complete or unequivocally supported by empirical evidence, some are adequately descriptive and supported to be judged useful.

A quite simple example of such a model is presented in Figure 1. The figure suggests that organizations obtain energy (inputs) from the environment which are acted upon and transformed (throughputs) to outcomes (outputs). As the model indicates, outputs can be conceived as either individual or organizational. The model also suggests both a temporal and causal sequence -- i.e., inputs precede and affect throughputs; inputs and throughputs shape individual outcomes; and, all three of these categories determine organizational outcomes. Feedback is suggested by the dashed lines to indicate that some reciprocal influence also exists.

In this model the social-psychological indicators fall mainly in the "throughput" category. For example, in the work at the Organizational Development Research Program at the Institute for Social Research the following factors receive extensive attention:

Figure 1

Model of Organizational Functioning


INPUTS
THROUGHPUTS
Social-Psycholog-
ical processes
Supervisory
Leadership
Peer
Leadership
Group Process
Organizational
Climate
INDIVIDUAL
OUTPUTS
ORGANIZATIONAL
OUTPUTS

- Supervisory Leadership
    - Supervisory Support
    - Supervisory Goal Emphasis
    - Supervisory Team Building
    - Supervisory Work Facilitation

- Peer Leadership
    - Peer Support
    - Peer Goal Emphasis
    - Peer Team Building
    - Peer Work Facilitation

- Group Process
    - Group Decision-Making
    - Confidence and Trust in Group Members
    - Adaptability of Group
    - Effectiveness of Planning and Coordination
    - Motivation of Group Members to Meet Objectives
    - Sharing of Information between Group Members

- Organizational Climate
    - Communication Flow
    - Motivational Conditions
    - Decision-Making Practices
    - Human Resources Primacy
    - Lower-Level Influence

Although not indicated, these social-psychological indicators within the throughput category of the model in Figure 1 can also be related to one another in a temporal and causal manner. Thus, a more complete model would specify relationships between the indicators falling within the throughput category. Although such models exist, empirical support of them is just beginning to emerge.

Information Gathering

A second major advancement with respect to the social-psychological factors is the development of methods which make the gathering of information about these factors relatively simple. An example of a tool used for this purpose is the Survey of Organizations questionnaire developed at the Institute for Social Research (Taylor & Bowers, 1972). This instrument serves as a standardized tool used to tap many of the social-psychological factors posited by models of organizational functioning. It has been used in approximately 40 organizations mostly in business and industrial settings and has the advantages of both a theoretical base and the availability of comparative data (norms) based upon 20,000 respondents. These norms provide standards for evaluating one organization or subpart thereof (e.g., level in a hierarchy) on the basis of comparisons to other organizations which have used the same instrument.

One distinguishing feature of the Survey of Organizations questionnaire is that it focuses primarily upon the situation in which people function and their actual behaviors rather than the affective reactions of individuals to these situations and behaviors. This focus suggests an assumption noted below that if one is to improve organizational functioning, it is a least as important to understand the causes of affective reactions -- i.e., conditions and behaviors -- as to identify the reactions themselves.

Systematic Organizational Improvement

A third major step toward using information about organizational processes as the basis of improving effectiveness has been the development of techniques for systematically improving organizational functioning. Although many techniques exist, the Organizational Development Research Program has come to rely upon a general approach termed Survey-Guided Development which has as its basis the collection and evaluation of information about social-psychological factors related to organizational effectiveness (Bowers & Franklin, 1972). The information deemed most valuable in this approach is that which describes the behaviors of organizational members and the situations in which they act rather than the state of output factors. One important advantage of the former is that they can be influenced more directly through corrective activities than the outputs themselves.

The Future

It appears that we are rapidly approaching a situation characterized by two important factors. First, the capabilities will be realized for gathering information about a multitude of factors of various types at many stages in a causal sequence which have known relationships to each other. For example, some progress has already been made in empirically relating a variety of social-psychological factors to each other and to output criteria (Bowers & Seashore, 1966; Drexler & Bowers, 1973; Taylor & Bowers, 1972). In the ideal state, the focus of our information gathering would be on those factors falling early in the causal sequence such that corrective actions could be implemented at the earliest possible time.

The second factor of the anticipated state would be the routine collection of such information such that it could be subsequently used as a basis for (a) identifying and defining strengths and weaknesses in organizational functioning, (b) matching basic causes of problems with corrective activities, and (c) evaluating the effectiveness of corrective activities in improving organizational functioning.

Research Needs

Four areas of concentration seem crucial to arriving at a point where these capabilities are realized. The first two are judged of primary importance and the latter two of lesser urgency. First, there exists the need for the further identification of factors crucial to organizational functioning and the specification of their temporal and causal relationships. Little research-based information is now available to support the relationships suggested by even relatively simple models indicating such relationships. The greatest barriers to such studies may well be methodological difficulties which, to some extent, are currently being resolved. However, even with the most recent advances, it seems evident that longitudinal data (probably from at least 3 waves of data collection) provides real advantages in the determination of temporal and causal sequencing.

A second major area in need of development is knowledge with respect to the appropriate matching of the identified causes of problems with corrective activities to attain maximal improvement in organizational effectiveness. Recent work in this area suggests that this problem is more complex than generally acknowledged (Bowers, Franklin, & Pecorella, 1973).

The remaining two areas are presented as lower priorities not because of their relative unimportance but rather on the basis of the relatively advanced state of current development. Three areas are (1) the further refinement of measurement techniques useful for measuring social-psychological factors, and (2) the further development and refinement of techniques useful for altering situations and behaviors related to organizational effectiveness.

Applicability for the Navy

There are many questions related to the usefulness of this information to the Navy. Are the theoretical notions about other organizations also appropriate to Navy settings? Can the desired information be conveniently gathered? Could the information be used in constructive ways to help solve organizational problems faced by the Navy? Based upon previous experiences with large civilian organizations and current contacts with the Navy as a contractor for the All-Volunteer Forces study, it would seem that each of these questions can be answered affirmatively.

For example, from the All-Volunteer Forces study it was found that data about social-psychological factors of work settings was easily gathered both on shore stations and aboard ships. In fact, it proved feasible to collect information using a modified version of the Survey of Organizations from a good representative sample of Navy personnel around the world. Aside from a few relatively minor logistical problems, the data collection activities proved rather easy compared with some attempts to collect similar data in civilian organizations. Respondents were generally conscientious and thorough in completing the questionnaires.

Aside from the actual mechanics of gathering such information is the question of its validity -- i.e., accuracy and usefulness. This is a more difficult question but, the information available to date indicates that the data is at least reasonably accurate. Statistical analyses suggest that the consistency of measures is equivalent to what is expected in civilian populations. Further, anecdotal evidence lends credence to the findings suggested in a recent diagnostic report based upon this information (Bowers & Franklin, 1973). In short, it seems that the collection of information about social-psychological aspects of the Navy as an organization and sub-units as smaller organizations is both possible and potentially useful.

Importance to the Navy

Another vital question relates to the importance of these social-psychological factors to the Navy. Theory suggests the importance lies in the causal influence of such factors over more obvious and causally subsequent factors effecting or indicating organizational effectiveness. Previously noted analyses based upon civilian data in fact have provided evidence supporting the theory. For example, relationships have been found between one or more social-psychological factor and grievance rates, total variable expenses, accident rates, and absence rates. Such data for the Navy seems largely unavailable. One exception is a recent study which examined the relationship between 16 social-psychological factors and retention rates aboard 20 ships and 2 air commands (Drexler & Bowers, 1973). The results of this limited study lends support to the notion that relationships do in fact exist between the kind of human or organizational system indicated by the social-psychological measures and the retention rates of these units. The duplication of such findings for other criteria -- e.g., performance ratings, cost of operations, quality of performance -- would strongly suggest the importance of social-psychological indicators of organizational effectiveness for the Navy.

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PROSPECTS FOR RESEARCH ON ORGANIZATIONAL CLIMATES

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The aim of this paper is to present some suggestions as to how research into organizational climates should proceed during the period between now and 1980. Figure 1 shows the structure the paper follows. The paper offers alternative views of the future because the data from the first three steps in the flow diagram in Figure 1 reveal that the concept of organizational climate may not be viable. How to judge it to be viable becomes the first topic of concern.

Evaluating a Concept or Research Activity

As Cartwright (1973) points out, "there are few established criteria for evaluating an entire field of investigation, the critical issue of research significance tends to be relegated to the realm of intuition and subjective judgement", but few scientists would argue that science should aim at achieving one or all of the following:

1. an accurate and reliable description which may ultimately form the basis of some taxonomic system
2. the ability to predict the behaviour of the organism or system under study
3. understanding of the way the organism or system functions.

Before examining how well the concept of organizational climate and the research associated with it has achieved each of these three goals it is necessary to try and define it.

Definition of the Concept of Organizational Climate

Collections of the various definitions of the concept may be found in Tagiuri and Litwin (1968) and Campbell et al (1970). On the basis of an examiniation of these the author (Payne, 1971) has offered the following definition: "Organizational climate is a molar concept reflecting the content and strength of the prevalent values, norms, attitudes, behaviours, and feelings of the members of a social system which can be operationally measured through the perceptions of system members or observational and other objective means". The one distinctive aspect of this definition is the notion that climate can be measured by 'objective' methods. All the studies which have set out to measure climate have done so by asking a representative sample of the people in the organization to say whether certain statements about the organization are true or not. That is, climate is measured by the perceptions of the system members. It is suggested here that reliable indicators of norms, values and attitudes could be obtained through collecting statistics on absence, lateness, and labour turnover, by use of the critical incident technique, or by systematic observation of the behaviour of people in the system such as is done by Roger Barker and his colleagues (1963) in their studies of "The stream of behaviour" and already applied to the study of organizations in their book, "Big School, Small School" (Barker and Gump, 1964).

Another distinction which is implicit in the definition is that climate is different from the formal organization structure. Likert (1967) for example defines the formal organization structure as an independent variable because it can be manipulated by management to alter the norms and attitudes of people (climate) which then has some effect on the end-result variables of output and performance. Conceptually then, structure is different from climate. This conceptual distinction has not always been maintained in the operational measures of climate. Campbell et al (1970) review a number of climate measures and conclude that there are at least these dimensions:

1. Individual autonomy or the freedom of the individual to be his own boss and not having to be constantly accountable to higher management.
2. Structure or the degree to which the objectives and methods of the job are established and communicated to the individual.
3. General reward orientation or the level of rewards available.
4. Consideration and warmth or support in a human relations sense.
5. Co-operation vs conflict.

In a factor analysis of a large number of measures of organization structural variables Pugh et al (1968) report four dimensions of structure:

1. Structuring of activities or degree to which roles are specified, standardized and formalized.
2. Concentration of authority or degree to which authority to take decisions is centralized at top of the organization.
3. Line control of workflow or degree to which control is exercised by line personnel rather than procedures.
4. Size of supportive component or percentage of non-production personnel, percentage of clerks, etc.

Campbell et al (1970) indicate that the first two climate dimensions, structure and autonomy, are very similar to the first two dimensions of organization structure. We wish to suggest that organization structure too can be operationally measured by subjective or objective methods and that the first two climate dimensions referred to above are actually better considered as subjective measures of the first two structural dimensions above.

Figure 2 is taken from Payne and Pugh (1973) and presents examples of studies which have operationalized the two concepts of structure and climate in these two ways. This fourfold classification was used as a framework for reviewing the literature on organization structure and organization climate and the structure of the review appears below. It is presented to the reader to help elucidate the concepts and to indicate the origins of some of the arguments which appear in the present paper.

Structure of Review of Literature on Organization Structure and Organization Climate

(a) Organizational structure and its concomitants, including subjective and objective methods of measurement.

(b) Organizational climate and its concomitants including subjective and objective methods of measurement.

comparison of: -

(c) Perceptual measures of structure and perceptual measures of climate.

(d) Objective measures of structure and perceptual measures of climate.

(e) Objective measures of structure and objective measures of climate.

(f) Organizational climate and individual characteristics.

  (i) climate and other variables when the data are collected from the same individual

  (ii) climate discrepancy scores and other variables when the data are collected from the same individual

  (iii) aggregate climate scores and aggregate individual attributes.

Having established what we mean by organizational climate it is now possible to attempt to evaluate it against the three criteria previously listed; description/classification, prediction and understanding.

Climate Evaluated Against Criterion of Description/Classification

An essential requirement of any classificatory system is that the basis on which the classification is made is readily verifiable by a third party so that two different people would arrive at the same classification. In the case of organizational climate this raises the problem of accuracy as Guion (1973) terms it. That is, do different people agree that the climate is of a certain kind? Table 1 presents some data from Payne and Mansfield (1972) which suggest that people from different levels in organizations have differing views about the climate. The data were collected from fourteen business organizations which differed considerably in size and product. The Business Organization Climate Index (Payne and Pheysey, 1971) was administered to samples of personnel at all levels of the workforce. The samples at the lower levels in the organization are random but not representative in terms of size. Level 0 in Table 1 refers to operating level employees and level 4 to chief executive level. The intervening levels refer to supervisory and middle management. The column of F ratios in Table 1 indicates that there were significant differences on six of the eight scales by organizational level. Examination of the mean scores reveals that generally speaking the higher one is in the organization the more favourably does one describe it. In other words there is not high consensus about the nature of the organization climate, and one cannot therefore treat a mean score as an accurate measure of the organization's climate.

A legitimate criticism of Table 1 would be that the data are from different organizations, and there may be consensus in individual organizations. Table 2 presents data from virtually all the management and supervision in one company. This is a manufacturing company which employs about 8,000 personnel. The table shows that the average mean size on each scale is about 4.0 and the standard deviation about 2.0. Given that these are 9 point scales, scoring 0 - 8, these means and standard deviations describe scales with a good distribution of scores covering the whole scale. There is little tendency to produce skewed or bunched distributions which would suggest that these managers and supervisors have an agreed view about their organization: the scale of rules orientation is a possible exception. Again it is not possible to conclude that a mean climate score accurately represents the climates in this company. Other studies making the same point have been reported by Schneider and Bartlett (1970) and Gorman and Malloy (1972).

On this basis alone we can conclude that measures of organizational climate do not provide an adequate description of organizations which could be used to provide a taxonomic classification.

Evaluation of Climate Against The Criterion of Prediction

This section assumes that prediction entails the use of measures which are reliable, and have both construct and predictive validity. Each of these three will be examined and predictive validity will be considered against two criteria: organizational performance and organizational job-satisfaction.

i) Reliability: the various measures of climate show acceptable levels of internal reliability (approximately 0.75). Test-retest studies are very rare. Payne and Pheysey (1971) report only one change out of 48 possible changes over a 7 week period, all of which suggest these sort of measures have the properties of internal reliability normally accepted for research purposes even though they are a some way from being perfect.

ii) Construct validity: construct validity is held to exist when the criterion measure relates to some other measure with which it could be expected to relate on theoretical or common-sense grounds. It was suggested earlier in this paper that organization structure should relate to organizational climate.

Table 3 presents data from three studies where a measure of climate is related to three variables of organization structure. The variables in the three studies were measured in exactly the same way, and the climate measure was obtained from directly comparable groups of people; namely the senior executives in the comapny. On average this was 7-8 people in each company. The measures of structure were objective measures operationalized according to the method described in Pugh et al (1968). Interpersonal-conflict was measured by four items rated on 5 point Likert scales and is described in Child and Ellis, (1973). The study identified on Table 3 as Birmingham was carried out on 25 manufacturing companies located in the Birmingham U.K. area. The Ohio sample was carried out from Kent State University and the organizations were again all manufacturing in that general region. Details of both studies can be found in Inkson et all (1970). The third column of Table 3 contains results from a study of service and manufacturing organizations from all parts of Britain (Child and Ellis, 1973).

Despite being 3 directly comparable studies Table 3 shows how unstable the relations between structure and climate are. The instability is unlikely to be due to sample differences since the 'odd man out' is a different study in each of the three rows. On this comparison of objective measures of structure and subjective measures of climate the construct validity of climate is called into question.

Table 4 explores the construct validity of the concept by comparing relationships amongst perceived or subjective measures of structure and subjective measures of climate. The data are taken from the same three studies described in the previous paragraph and the methods and measures are once again directly comparable. Child and Ellis describe all the measures in detail, but they are either Likert scales or semantic-differential ratings. The boxes represent relationships which appear to be unstable across the three studies. Relationships amongst the perceived measures of structure are very stable, but as soon as climate variables are used their relationships with structual variables and other climate variables seems to be quite unstable. Construct validity is poor.

iii) Predictive validity: when organizations are the unit of analysis there are not many studies relating climate to measures of organizational performance and satisfaction. Stern (1970) has found high relationships between the mean dimensions of his College Characteristics Index, Intellectual Climate, and various measures of college and university performance. These appear in Table 5. These data are not too generalizable, however, since it is almost a tautology that organizations which take in people with high intellectual standards also output people with high intellectual standards and in doing so create a climate with a high interest in intellectual matters. Other dimensions of the climate are not mentioned as relating to performance indices.

Pritchard and Karasick (1973) report a study where climate was related to measures of organizational performance and organizational satisfaction. Table 6 presents correlations between climate and performance and satisfaction using the organization and the individual as the units of analysis. As there are only 5 organizations in the study, rank order correlations were used to analyze the organizational data. The organizations were in fact 5 regional offices within the same organization and this means that performance data is comparable. The performance measures for individuals consist of supervisory ratings of overall performance. With only five organizations in the sample it is difficult to place much confidence even in correlations of 0.9, but the pattern of relations between climate and effectiveness makes some sense. More effective organizations appear to have climates low on structure, high on flexibility and are decentralized. Conceptually we should regard structure and decision centralization as subjective measures of structural variables so that the only genuine climate relationship is with flexibility-innovation. Taylor and Bowers (1972) also report a study of six organizations which show some relationship between climate and performance, but as they observe, "Certainly this small finding is far from conclusive, it raises perhaps more questions than it answers." One question it raises is why measures with such poor construct validity appear to have some predictive validity. Aggregating measures to construct an organizational score which is then related to another variable is, as Guilford (1954) indicates, a tactic which requires the most careful inspection, and in this case a lot more data before such inspection could be thorough.

To some extent Table 6 alerts us to the danger mentioned in the previous paragraph. When the individual is taken as the unit of analysis the relationships between climate and effectiveness, and between climate and satisfaction, are very different from those at the organizational level of analysis. As Bachman et al (1966) have recommended, when there are relationships between two variables at the individual and aggregate levels of analysis it is necessary to partial out for the relationship at the aggregate level, before assuming that the relationship at the aggregate level really does contain something unique to that level of analysis.

The level of analysis question is also relevant in another way. It is implicit in the Pritchard and Karasick work that organizational climate has an effect on individual satisfaction; but a more parsimonious explanation of the relationship may be that satisfied individuals may see the climate in a different way than dissatisfied individuals. The danger is that data collected from individuals and analyzed at the individual level can be interpreted as saying something about the organizational level of analysis. This error is committed more blatantly by George and Bishop (1971) in a study of over 200 teachers form 15 different schools. They had measures of personality, organization structure and organization climate but all measures were provided through the perceptions of the individuals. These data were analyzed across the individuals but interpreted as saying something about organizations. Thus it is important to keep the conceptual distinctions between different levels of analysis, and when they are maintained the correct methodology must be used to apportion the variance between individual and aggregate effects.

Whilst looking at the relationship between climate and satisfaction it seems useful to raise two more connected issues. The first is to do with the distinction between cognition and affect. A person completing a climate questionnaire is asked to describe how he sees the organization. A person completing a job-satisfaction questionnaire should be asked to say how he feels about or evaluates his job. Climate is a descriptive measure and job-satisfaction an evaluative measure. Unfortunately, these distinctions have not been rigorously maintained in constructing the two instruments. The Cornell Job Description Index is intended to measure job-satisfaction yet it is a measure which includes many descriptive statements. The authors did this quite deliberately and argued that ones description of a job will be strongly influenced by how one feels about it, and therefore reflects how one feels about it. This is unquestionably true for many aspects of the job, but not necessarily true for all aspects. This is illustrated by the information in Table 7 which divides the items in "The Work Itself" scale of the JDI. The table also shows that the evaluative items correlate amongst themselves and with another evaluative measure of job-satisfaction--the Hoppock scale (Hoppock, 1935), but they do not correlate with the descriptive items. The descriptive items do not correlate with each other (are not a scale) nor do they correlate with the Hoppock scale. Here is at least one example when description and affect are not related. The relevance to studies of climate is that when measures of satisfaction (or climate) contain both descriptive and evaluative statements it is difficult to know whether relationships between the two are due to communality of descriptive items or the effect of affect on perception.

The second issue we want to raise concerns the communality of content in measures of climate and job-satisfaction. Johannesson (1971) has content analyzed a number of measures of climate and job-satisfaction and shown that there is considerable overlap. For example, both measures ask about supervision. His tentative conclusion is that climate is a duplicate of job-satisfaction. In a later article (1973) Johannesson attempts an empirical investigation of the question by examining the relationships between two measures of job-satisfaction (the JDI and the Science Research Associates index - SRA) and a 90 item organizational climate measure. The items in each of the three measures were cluster-analyzed separately. This produced 8 JDI clusters, 8 SRA clusters and 6 climate clusters. Cluster scores were calculated for these 22 clusters and these then submitted to a further cluster analysis. Three of the five clusters contained scales from both satisfaction and climate measures. Johannesson concluded that there is 'substantial redundancy' in the two concepts, and that the relationships could be interpreted as saying that 'satisfaction causes satisfaction.'

Johannesson's conclusions can be questioned on two grounds Firstly, the measures are conceptually different--one is descriptive and the other evaluative. The fact that the two sometimes, and only sometimes, correlate does not make this conceptual distinction redundant, but rather supports the construct validity of each. Secondly, the data do not justify the conclusion that there is substantial redundancy. Table 8 summarises the correlation matrix for the 22 clusters by showing the highest, lowest and median correlations among the three measures. Thus the average correlation between job-satisfaction and climate is about .3 and between the 2 job-satisfaction measures is about .25. There is something like 30% common variance between climate and job-satisfaction measures, but the predictable variance is only about 9% and hardly seems to justify being regarded as substantial. Perhaps a more realistic interpretation of Table 8 is that the convergent and discriminant validity of the job-satisfaction measures is so poor as to make all this data difficult to understand. Despite all these difficulties has the concept of climate increased our understanding of how organizations function?

Climate Evaluated Against the Criterion of Increasing Understanding

From a strictly scientific viewpoint it might seem almost stupid to ask whether a concept that has such poor construct and predictive validity has increased our understanding. Generally in science if one can predict and control phenomena one can claim also to be able to explain or understand the phenomena. In medicine, however, drugs are often used to control behavior and we can predict their effects, but we don't necessarily understand why they act in the way they do. Understanding is used here in the sense that Spranger (1928) used it. Understanding, unlike explanation, seeks no basic causality, but rather a "nexus" of meaning relationships. It is a complex theoretical act in which we grasp the inner, meaningful nexus in the life and actions of individuals (or organizations).

The great novelists and philosophers have provided many examples of increasing our understanding of human behavior even though they would find it as difficult as anyone else to predict and control. In the field of organizational psychology recent writings in organizational development by Bennis et al, (1968), Argyris (1970) and Lawrence and Lorsch (1970) seem to provide frameworks and descriptions of organizations which help one to grasp how they function, and how one might go about coming to an understanding of them. These writings refer to hardly any experiments and many of the measures used are unreliable and invalid yet there is still a feeling of increased understanding from reading them. Has the concept of climate contributed to this understanding?

A cautious answer would be, "To some extent". Tagiuri (1968) suggested that one of the advantages of climate is that "it is a summary term which is uncluttered by its individual components and this encourages the production of generalizations." In practice the concept is multidimensional and generalizations about it are rare. The largest body of data which has been collected about it has probably been collected through Likert's (1967) organizational survey questionnaires where a host of variables are assumed to be affected by various management strategies and structures. Until recently, however, this work has not used the concept of organizational climate at all. It is one example of broad generalization occuring, though empirically the dimensions and the relationships amongst them turn out to be many and complex (Taylor and Bowers, 1972). If such generalization is useful then climate was not necessary as a concept to generate it, and in our opinion it is not so much the generalizations from this work that are useful but the detailed empirical findings that have flowed from it. If the concept was useful in initiating attempts to conceptualize and measure the environment in which behavior occurs then it has been useful but its future utility now appears to be in question. Assuming researchers still do accept climate as a useful concept what sorts of research should it generate in the next few years?

Some suggestions for the Future if Climate is Retained as a Viable Concept

i) To study what sort of things people in organizations do agree about. That is to try and get round the accuracy or consensus problem by finding out what agreement exists about and whether such information is informative and useful: perhaps people only agree about relatively trivial or conceptually unimportant things. This will also entail deciding what level of consensus is acceptable - 100%, 90% or 60%?

ii) Assuming consensus is easier to find within small groups in the organization it might be useful to develop techniques for describing the pattern of climates that exist rather than relying on a mean score. The Institute of Social Research at Michigan already presents profiles for different levels in the organization, but these may not be the most natural groupings and more fruitful results might be achieved through cluster analysis combined with some sort of description of the pattern of clusters. Techniques developed for the repertory grid may be applicable.

iii) Future studies of climate and job-satisfaction should be careful to maintain the distinction between descriptive and evaluative measures. Perhaps all climate items should be followed by the question, "And how satisfied are you with that state of affairs?" Other aspects of job-satisfaction could be measured separately.

iv) The methodological problems involved in using aggregate scores from individuals to represent some larger social structure should be noted and steps taken to overcome them. Stern (1970) has already indicated one way in which this can be achieved.

Some Suggestions for the Future if Climate is Rejected as a Viable Concept

i) Assuming that researchers still feel it is necessary to try and describe the socio-psychological environments created in organizations then it may be worthwhile to try and explore the value of more objective methods of investigation such as those used by Barker in his studies of the "Stream of Behavior". In addition, to investigate the value of non-reactive measures of research and statistical data which may give clues as to the nature of the norms and values present in the organization.

ii) To reject large scale comparative studies of organizations due to the inadequacy of the data they provide. As Argyris has so eloquently pointed out there are some unintended consequences of rigorous research methods. Namely that subjects are put in a situation similar to that of a boss-subordinate and this produces a relationship of distrust, non-involvement, giving the researcher what he appears to want and getting him off your back as quickly as possible. The remedy Argyris (1970) suggests is the organic research model outlined below:

1. Researcher and subjects define research goals together.
2. Subjects are encouraged to question and get to know the researcher personally.
3. Subjects choose how much they wish to influence the researcher.
4. Researcher encourages the subjects to define and control the research to make them feel as responsible for it as he is.
5. Subjects help to design the instruments, methods and use of data (i.e. the change strategy).
6. Data are fed back so as to help make the subjects more effective as people.

The time commitment involved in such a research process would permit only small comparative studies but if the organizations were carefully selected to test out hypotheses, such as the effects of bureaucracy, centralization etc. they might give some good, valid data about the processes, norms, attitudes and values that are really operative in the organizations compared. One of the limitations of case-studies and small-scale comparative studies is that it is difficult to see how they can be integrated so that knowledge accumulates in a systematic way. The Navy appears to have a golden opportunity to ensure that such studies do accumulate. This could be done by organizing gatherings of research workers who could then agree what sorts of issues need testing and return to their organizations to test them. Perhaps if we are to understand organizations we researchers need to get organized!

iii) It might also prove valuable to apply the methodology of the single case study currently being carried out in clinical psychology. This involves developing measuring instruments for the particular case. Thus a questionnaire or interview schedule is designed in the specific terms of the individual (or the individual organization) under study. The instruments are then administered over time to detect developments or stable patterns in the elements studied. Weick (1972) has developed a technique for studying the processes at work in an orchestral rehearsal which could be used in this way. It involves identifying the variables effecting orchestral performance, and then casting them into a matrix and asking the members of the band to say which variables are connected to which, in which direction and to what strength: a sort of phenomenological causality. This gives a picture of the various processes at work and by analyzing the number of positive and negative signs helps to identify whether the feedback processes are positive (and the rehearsal gets worse) or whether they are negative and thus self-correcting. This would appear to be a powerful method for studying such things as control, decision-making or stress in organizations. The content of the matrix would be tailored to the individual organization of course but combined with the longitudinal application required by the individual case method could provide some very interesting information about organizational functioning. Such methods also have the advantage of being quantifiable and allowing the use of powerful statistical methods. Nor do they preclude comparative studies since the content of the matrices produced in different organizations could be compared and where they are the same satistical tests could be used to examine differences. At the same time those things unique to the particular organization are not lost and organizations can be compared in their uniqueness. It has always slightly bothered me that conventional scaling methods reject what is unique.

If the overall impression of this paper is one of negativism towards research on the concept of climate then it is perhaps worth reminding ourselves that science proceeds by attempting to disprove its hypotheses. If we now reject the concept of climate let us not forget that this has increased our understanding if not our ability to predict and control.

FIGURE 1

STRUCTURE OF PAPER

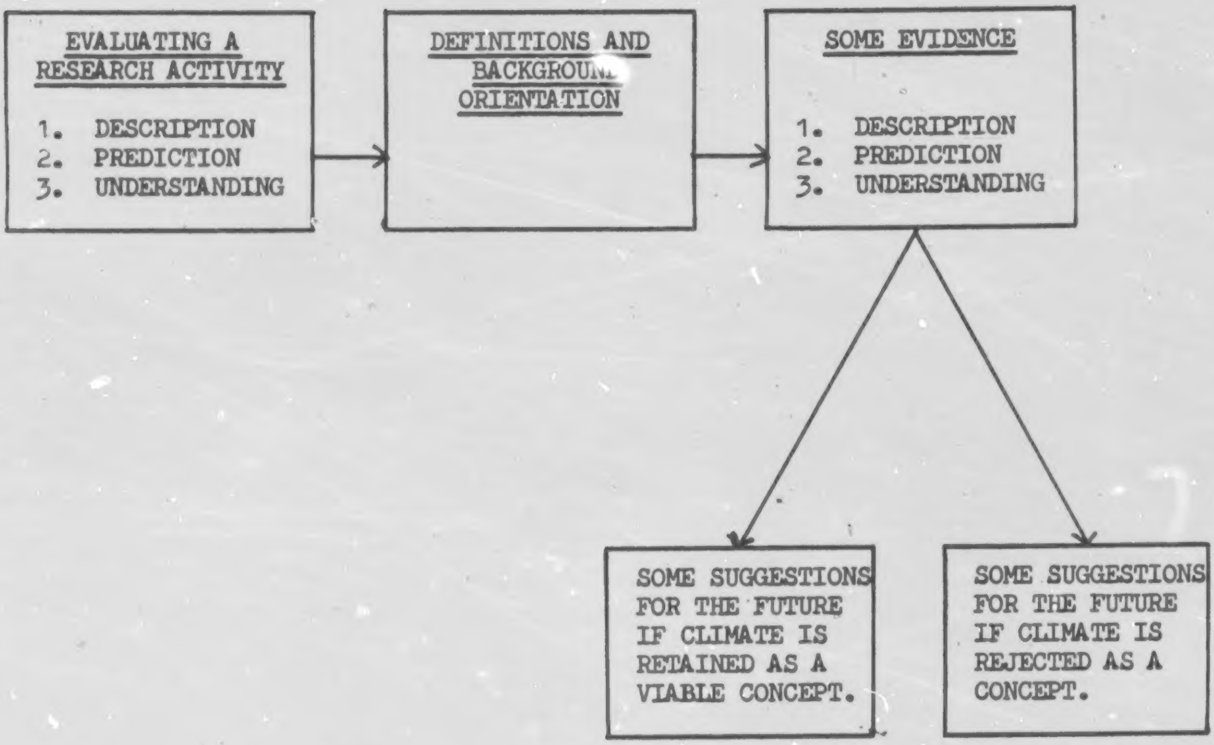
EVALUATING A RESEARCH ACTIVITY
1. DESCRIPTION
2. PREDICTION
3. UNDERSTANDING
DEFINITIONS AND BACKGROUND ORIENTATION
SOME EVIDENCE
1. DESCRIPTION
2. PREDICTION
3. UNDERSTANDING
SOME SUGGESTIONS FOR THE FUTURE IF CLIMATE IS RETAINED AS A VIABLE CONCEPT.
SOME SUGGESTIONS FOR THE FUTURE IF CLIMATE IS REJECTED AS A CONCEPT.

FIGURE 2

SUBJECTIVE AND OBJECTIVE OPERATIONALIZATIONS OF CLIMATE AND STRUCTURAL VARIABLES

	CLIMATE	STRUCTURE
SUBJECTIVE	1. Risk and Support dimensions from Campbell et al 2. Development and Progressiveness and Normative Control dimensions from Payne and Pheysey	1. Structure and Autonomy dimensions from Campbell et al 2. Job-codification, Centralization and Hierarchy scales from Hage and Aiken
OBJECTIVE	1. Classification of Behaviour Settings and Behaviour Episodes based on observation from Barker 2. Analysis of Critical Incidents as per Flanagan 3. Statistics on turnover, lateness and absenteeism etc.	1. Structuring of Activities, Concentration of Authority, Line Control of Workflow from Pugh et al 2. Various measures of Complexity and Configuration from Blau and Schoenherr

TABLE 1

MEAN CLIMATE SCALE SCORES FOR PERSONS AT EACH HIERARCHICAL LEVEL, AND ANALYSIS OF VARIANCE ACROSS LEVELS

	Level 0 N = 195	Level 1 N = 87	Level 2 N = 82	Level 3 N = 14	Level 4 N = 9	F Ratio
Leaders' Psychological Distance	3.99	3.59	3.09	2.21	2.22	7.28^{xxx}
Questioning Authority	4.47	4.47	4.57	4.29	5.11	0.35
Future Orientation	3.74	4.29	4.61	4.71	6.00	5.26^{xxx}
Industriousness	3.82	3.87	5.16	5.57	6.56	8.52^{xxx}
Interpersonal Aggression	4.49	3.87	3.24	2.29	1.33	9.94^{xxx}
Rules Orientation	3.68	3.57	3.99	4.43	4.00	1.65
Readiness to Innovate	3.21	3.84	4.02	4.93	5.67	7.01^{xxx}

x signifies $p<0.05$
xx signifies $p<0.01$
xxx signifies $p<0.001$

TABLE 2

MEANS AND S.D.s ON 8 CLIMATE SCALES IN 'SMOKESCREEN'

	Mean	S.D.
Leaders Psych. Distance	3.47	1.86
Questioning Authority	3.94	1.98
Emotional Control	4.32	1.86
Future Orientation	5.27	2.16
Industriousness	5.04	2.19
Interpersonal Aggression	2.96	2.28
Rules Orientation	5.74	1.51
Readiness to Innovate	4.67	1.91

N = 340

each scale has 9 points, scored 0 - 8.

TABLE 3

CORRELATIONS BETWEEN 3 MEASURES OF ORGANIZATION STRUCTURE AND ONE DIMENSION OF CLIMATE FOR 3 DIFFERENT SAMPLES

Organization Structure Variables	Perceived Interpersonal Conflict Amongst Top Managers		
	Birmingham U.K. N = 25	Ohio N = 17	Britain N = 78
No. of Employees	-43	-12	-05
Structuring of Activities	-34	-18	31
Centralization	-02	43	-01

TABLE 4

CORRELATIONS BETWEEN PERCEIVED STRUCTURE AND PERCEIVED CLIMATE VARIABLES FOR 3 STUDIES

		Structural Variables			Climate Variables		
		Role Form'zn	Routine	Definition	Innovative Expectations	Innovative Behaviour	Interpersonal Conflict
		1	2	3	4	5	6
2	a.	-24					
	b.	-22					
	c.	00					
3	a.	43	26				
	b.	76	18				
	c.	49	34				
4	a.	35	-66	07			
	b.	-34	17	04			
	c.	10	-48	-27			
5	a.	09	-44	-06	50		
	b.	01	44	-01	-02		
	c.	33	-37	06	34		
6	a.	-01	47	10	-39	-44	
	b.	11	01	09	-24	-12	
	c.	36	03	08	-02	37	

(a) 25 Birmingham, U.K. Manufacturing organizations, top managers only

(b) 17 Ohio manufacturing organizations, top managers only

(c) 78 British manufacturing and service organizations, top managers only

TABLE 5

CORRELATIONS BETWEEN INTELLECTUAL CLIMATE SCORE (CCI) AND OTHER MEASURES OF ACADEMIC QUALITY FROM STERN, 1970

	n	r
Knapp-Greenbaum Index: "scholars" per 1000	50	.80
Percentage of graduates receiving Ph.D., 1936-1956	37	.76
Percentage of Merit Scholar entrants, 1956	41	.49
Merit Scholars per 1000, 1960	25	.59
National Merit Scholarship Qualifying Test means	38	.71
CEEB-SAT Verbal means	16	.83
CEEB-SAT Mathematical means	16	.34

TABLE 6

CLIMATE, EFFECTIVENESS AND SATISFACTION

Scale	Effectiveness		Satisfaction	
	Org.	Ind.	Org.	Ind.
Structure	-.70	-.07	.90	-.32
Level of rewards	-.30	.24	.10	.66
Status polarization	.90	-.14	-.50	-.39
Flexibility-innovation	1.00	.08	-.10	.42
Decision centralization	-.70	-.04	.60	-.39

N=5 N=71

From Pritchard & Karasick, 1973.

TABLE 7

SUMMARY OF INTERRELATIONSHIPS AMONG DESCRIPTIVE AND EVALUATIVE ITEMS IN JDI SCALE 'WORK ITSELF' [1]

Evaluative items	Descriptive items
satisfying	needs a lot of skill
better than other jobs I've had	same day after day
worthwhile	needs a lot of experience
boring	takes it out of you
wrong sort of job for me	simple
	routine
mean inter-item r = .50	mean inter-item r = .12
mean item r with Hoppock = .56	mean item r with Hoppock = .13
mean inter-item r between descriptive and evaluative = .12	

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[1] These data and the ideas behind them are attributable to my colleague Toby Wall.

TABLE 8

MAXIMUM, MINIMUM AND MEDIAN CORRELATIONS AMONGST SIX CLIMATE CLUSTERS, 8 JDI CLUSTERS AND 8 SRA CLUSTERS

	JDI			SRA		
	max	min	median	max	min	median
SRA	.67	.08	.25			
OC	.66	.05	.25	.61	.10	.33

From Johannesson, 1973.

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ORGANIZATIONAL EFFECTIVENESS: DISCUSSANT

James K. Arima

As discussant of the splendid papers just presented, I propose to examine, first, the status of organizational effectiveness research in the Navy. Next, I shall try to explain why organizational effectiveness research occupies the status that it does. Then, I shall attempt to relate the approaches and ideas expressed by the speakers today with respect to their potential for improving the status that organizational effectiveness research presently occupies. Finally, I shall add some comments of my own as to what directions organizational effectiveness research might take to be, itself, more effective.

In order to appraise the status of organizational effectiveness research in the Navy today, I shall make use of some data collected in a survey to evaluate project selection for personnel and manpower R&D in the Navy. The respondents, numbering 200, included senior Navy Officers in the Bureau of Naval Personnel and OPNav, the entire professional staff of the Personnel Research Division, almost everybody from top management down to and including project leaders in the, then, Washington and San Diego Navy personnel R&D laboratories, a group of middle managers in the Navy--mostly lieutenants and lieutenant commanders, the heads and directors of civilian contractor organizations doing work for the Navy in personnel R&D, and members of the Advisory Panel for Personnel Research Laboratories of the Naval Research Advisory Committee. These people were asked to rank 18 R&D program elements (Fig. 1) according to two criteria. One was military significance, defined as the importance of payoff to the Navy of successful research in the area of the program element. The other was investment risk, defined as the probability of a successful research effort independent of its payoff. One of the elements to be ranked was organizational effectiveness research, defined as follows:

> Development and evaluation of techniques for measuring overall military effectiveness of organizational units under various contingencies. This involves the development of empirically based criteria and the relative importance of criteria which should be applied in making judgments of organizational effectiveness. It includes studies of individual and organizational behavior and evaluative research into managerial practices and organizational characteristics. The principal objective is the enhancement of organizational effectiveness in relation to organizational goals and total system effectiveness.

Listed as a typical project under the program element was one called "Development of concepts and criteria for organizational effectiveness."

The first graph (Fig. 2) shows the scaled results of the rankings for the entire group of respondents for the military significance criterion. As it has been brought out in this conference, the Navy community seems to be most willing to see what it can do about manipulating individuals to improve the status of the Navy as a whole. Educating, retaining, recruiting, and getting them to perform better will result in the greatest payoff, according to this slide. Organizational effectiveness research gets very short shrift here. The idea seems to be that, if we take care of the individual personnel problems, organizational effectiveness will take care of itself. It may also mean that the respondents have their own ideas of organizational effectiveness research and do not believe the definition given--to enhance total system effectiveness. If they believed it, it would have to be ranked first. My hunch is that they equate "organizational effectiveness" with the exhortations and practices of the practitioner--the OD change agent--rather than the researcher's definition of organizational effectiveness.

The next graph (Fig. 3) is for the senior Navy officers--the sponsors and monitors of the R&D efforts listed. The pattern seen here is distinctly much more of the same. They seem to be saying, "Set up your requirements, recruit and retain your personnel, distribute and assign them optimally," and the other things are of relatively minor importance.

The next graph (Fig. 4) is for the middle managers in the Navy--the users of research products. Again, we have more of the same. "Retain them, train them, get their performance up," is the message I see here.

This graph (Fig. 5) is for the advisory panel, which represents the academic viewpoint. At this stage, everyone is apparently convinced that you must hold on to people or there will not be a Navy to worry about. But the programs next in order of precedence are quite different from the previous slides. They show a strong emphasis on the payoff to be obtained from organizational effectiveness research and research to improve the attitudes and motivation of Navy personnel. Their emphasis on education and training research, along with the emphasis on organizational effectiveness and attitudes and motivation, implies a broader conceptualization of Navy education and training than the emphasis given it by the middle managers (Fig. 4), for example. The latter pair it with research to enhance individual performance, suggesting that their emphasis was on the traditional areas of skill training.

Projecting these results into the future, the '80's, the advisory panel results can be interpreted as saying that the world and the Navy are changing; that problems in traditional research areas, such as selection, training, classification, and occupational areas, cannot be divorced from the aspirations, and life style of the individuals and society in general; and that only research in the larger context of the total organizational setting will solve the intricate personnel-related problems that are presenting themselves to the Navy.

Now, we shall turn to the investment risk criterion. Here, you will find that the higher the scaled value, the greater is the probability of a successful research effort and the better it is as an investment risk.

As previously, the first graph (Fig. 6) presents the results for the entire group of respondents. The picture has changed considerably from the graph for the military significance criterion, but organizational effectiveness research is even lower in priority than previously. It is grouped with research in the areas of drugs, attitude and motivation, and minorities as the poorest risk from a research standpoint.

Here is the graph (Fig. 7) for the senior Navy personnel. Note where organizational effectiveness is.

The next graph (Fig. 8) is for the middle managers of the Navy. They still see the greatest probability of successful research efforts in the traditional areas which we have referred to as individual personnel manipulation. Organizational effectiveness research takes a definite back seat.

Now imagine what the graph for the advisory panel will look like on this criterion. Here, then, is the graph (Fig. 9) for the academic side of the house. They also see that research in the areas of attitudes and motivation and organizational effectiveness are very difficult relative to research in other areas. Incidentally, the criterion included a 10-year period for a successful effort to take place, so in keeping with the theme of the conference, this chart does take us well into the '80's. Considering this chart along with the military significance rankings for this panel of judges (Fig. 5), I would not anticipate much argument if I were to say that, according to the advisory panel, the areas of research where the greatest payoffs to the Navy seem to lie are also areas where the probability of successful research efforts are most difficult to attain. Where the two are more-or-less consistent, as in the other pairings of figures on the two criteria, there is no great decision problem because unsuccessful research efforts are seen as most likely to occur where the apparent payoffs to the Navy are the least. This implies that research techniques have been developed to meet those needs that are large and leads to the position that current research should be programmed to cash in on such developments. Eventually, this position says "do more of the same, but do it even better." Unfortunately, this path may lead to stereotyped behavior and insensitivity to subtle changes in the needs of the organization--i.e., the Navy. It may even lead to the situation where endearment with capabilities and techniques leads to exquisite solutions without finding out what the problem really is. If this trend is in the making, the advisory panel may be giving a message that says, "We are hurting and need a lot of effort and improvement in the areas of attitude and motivation research and research in the broad area of organizational effectiveness."

How can this message be put across to the Navy R&D community and the sponsor/user of personnel and manpower R&D? It may turn out to be a difficult process, but we must convince the sponsor, especially, that doing something about the organization may come first and that solutions in the other problem areas will not come about without solutions in the arena of greater problems. That is, the problems that they, the sponsor/users, see in the areas of recruitment, personnel performance, and retention may only be solved by very serious effort directed toward improving the various aspects of organizational functioning, the organizational climate, and the organizational image.

Turning now to the papers that were given today, I would like to single out the emphasis given to defining just what is organizational effectiveness. I feel that this is one of the most important areas for two reasons. First, the definition of organizational effectiveness given by a researcher tends to determine the phenomena that he will examine and the direction of his efforts; when all researchers are taken as a group, their definitions define the field of organizational effectiveness research. Secondly, the definition of organizational effectiveness, with emphasis on effectiveness measures, is the most direct and convincing approach to the decision-maker, line person, or sponsor of research. It is our means, as researchers, of communicating to him what organizational effectiveness research is about and what it can do for him.

Accordingly, when we are doing research for a military sponsor, we must, as both John Campbell and George Milkovich pointed out, find out what he is thinking in terms of effectiveness. Then, it must be shown how our research contributes to his ideas of "total system effectiveness." This, in turn, requires us to look at our research in a hierarchical framework of inputs and output measures, as described by John Campbell. The picture that appears is not unlike the concept of linkage pins in a management structure that Jerry Franklin presented in his paper. That is, goals or objectives at one level of research become inputs at another level--ends become means and means become ends. This chain must have much face validity for the decision-maker and sponsor of organizational effectiveness research.

At this time, I would like to call your attention to one focal point where hard thinking takes place about military effectiveness measures. I have had the privilege of being on the board of directors of the Military Operations Research Society for the last four years. We hold two symposia a year and as far back as I can remember, we have had a very viable working group on measures of effectiveness at each of the symposia. Some of their deliberations are recorded in the proceedings of the symposia, but the only way to get the details and flavor of the discussions is to take active part in the working group sessions.

The papers in this session also touched on the question of "What should measures of effectiveness look like in organizational effectiveness research?" The complexity of this question has been clearly presented by John Campbell, and one of his conclusions is that you just can't add up the output and call it effectiveness. He has also brought out the need for a unit-effectiveness, "overall value" measure, if we are to do research in which the unit, and not the individual, is the focus of research--the degree of freedom.

George Milkovich's presentation has brought out the considerations that one must weigh in coming up with a measure of unit effectiveness, such as the Naval Personnel Status Index (PSI). George debated the value of a single number index versus a profile measure. My feelings are that, from the standpoint of a strictly effectiveness measure, one single number would be highly desirable because there are many powerful techniques for making that number an objective function and applying specific effectiveness criteria to it, such as maximization, minimization, minimax, etc. On the other hand, a profile measure is advantageous from the viewpoint of the researcher for its heuristic and diagnostic value. Unfortunately, a good measure (quantification) of a profile has yet to be developed.

Another feature of the presentations that is worthy of comment is what they had to say, explicitly or implicitly, about methodology. I feel that John Campbell set the scene for us in this area by emphasizing, first, the distinction between the attitudes of the OD practitioner and the researcher in organizational effectiveness. Then John emphasized the profound difference in approaches to the study of organizations that exist between the goal-centered viewpoint and the natural systems viewpoint.

With respect to the first dimension, let us call it the practical-abstract dimension, the presentations varied considerably. Jerry Franklin's presentation was close to the practitioner's world in that the four-factor model that was being developed was to be applied to the intervention process--the change-agent role of the OD practitioner. George Milkovich's presentation was also close to the developmental end of the research spectrum in attempting to determine an objective function that was meaningful to real Navy organizations. Roy Payne's presentation emphasized the gathering of empirical data to show that it is difficult, but possible, to use the unit or organization as the degree of freedom, and to impress on us again the efficient and pragmatic approach that so often characterizes research in Great Britain. Finally, and returning to John Campbell, he seemed to be advocating a careful study of independent, process, and dependent variables and their relationships. Such a method would be more abstract than the others and yet more generalizable.

All presentations spoke of the necessity of models, but only Jerry Franklin mentioned models in the sense of computer simulations of organizational processes and whole organizations. I feel that this route could do much for organizational effectiveness research in that it would take some of the attention away from measurement and focus efforts on data availability, as mentioned by both George and Jerry. Jerry mentioned that persons who take the computer modeling approach are not very much concerned with measurement, and I might add that this may be so because, if they don't like what they see, they can change it easily as the data become available. The simulation route would also make it possible to accomodate John Campbell's ideas in that organizations could be the degrees of freedom with concern only for computer time and that the parametric relationships among variables could be investigated rigorously using sensitivity analysis techniques. Validation of the computer model would provide a comprehensive framework for empirical research and data collection.

None of the papers, it seemed to me, took up the natural systems approach to the study of organizations. It may be because the ideas are newer, more abstract, and more difficult to apply in a particular setting, such as a specific type of Navy organization, than the goal-centered approach. The latter is apparently more simple and straightforward in that the organization is seen as a set of rational decision-makers. It articulates well with the theory of formal organizations, which is specially appropriate in the instance of military organizations. But the natural systems approach, which is often called the open systems model, may have great value in the investigation of Navy organizations in the '80's. Stating it overly succinctly, the theory states that the function of an organization is to survive, and its effectiveness is its viability (Ashby, 1968; Katz & Kahn, 1966; Seiler, 1967). This conceptualization of an organization would seem to be true of the Navy, whether the battle is with Capitol Hill in peacetime or a sophisticated enemy in high-intensity warfare.

Short Title	Full Title
Drugs	Drug Abuse
Educ./Trng.	Education and Training
Occupat. R&D	Occupational Research and Development
Costs	Manpower/Personnel Cost Systems
Requirements	Manpower Requirements
Management	Personnel Management Systems
Man-Machine	Man-Machine Systems R&D
Select./Class.	Selection/Classification
Applied Sys.	Applied Systems Development
Careers	Career Structures
Retention	Personnel Retention
Attit./Motiv.	Attitude/Motivation
Minorities	Minority Discrimination Measurement and Reduction
Org. Effect.	Organizational Effectiveness
Dist./Asgmt.	Distribution/Assignment
R&D Mngmt.	R&D Resources Management
Recruitment	Recruitment/Procurement
Performance	Personnel Performance

Fig. 1. Navy personnel R&D program elements ranked by judges. The short titles will be used in subsequent figures.

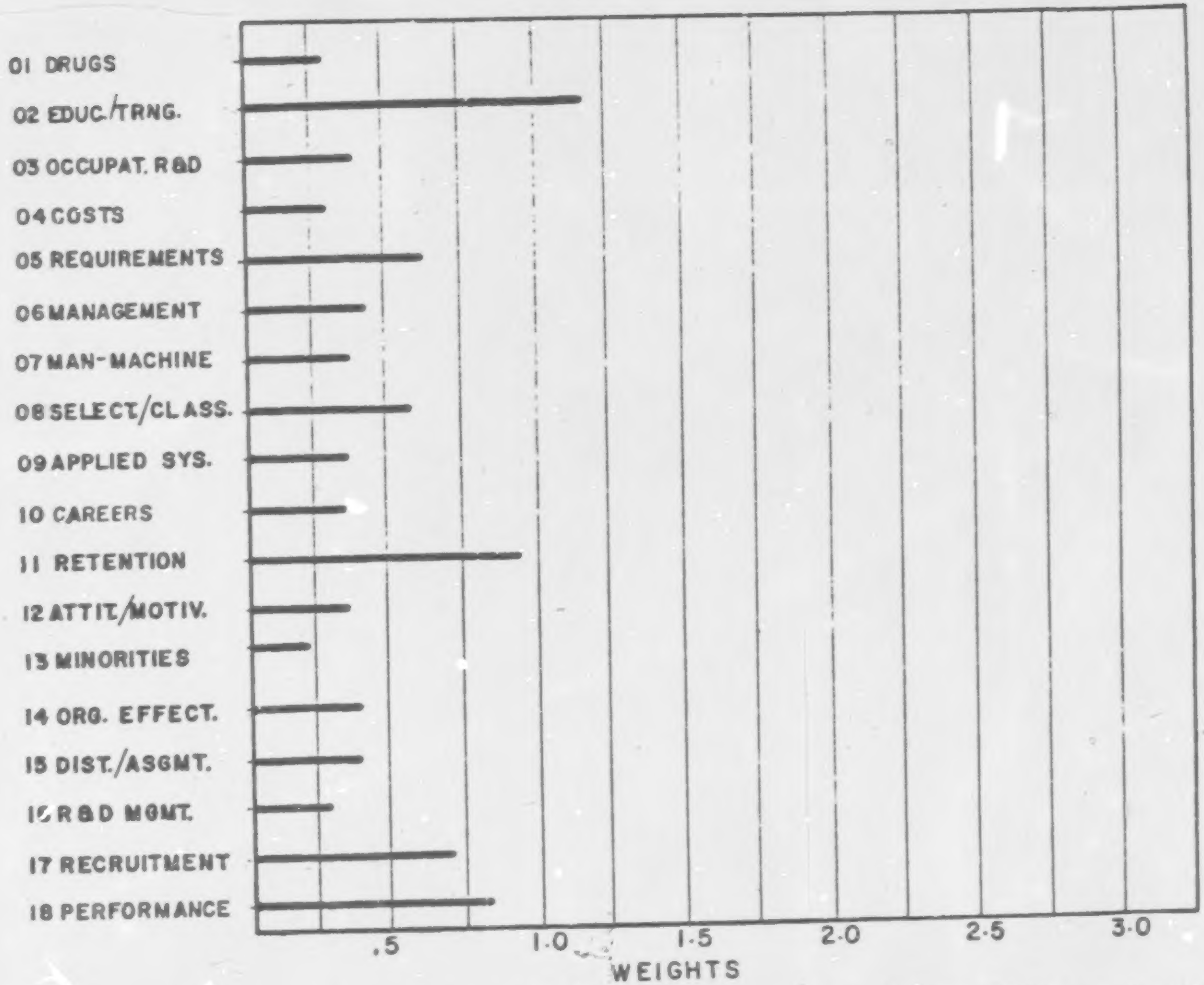

Fig. 2. Relative importance (weights) of program elements on the military significance criterion for all panels.

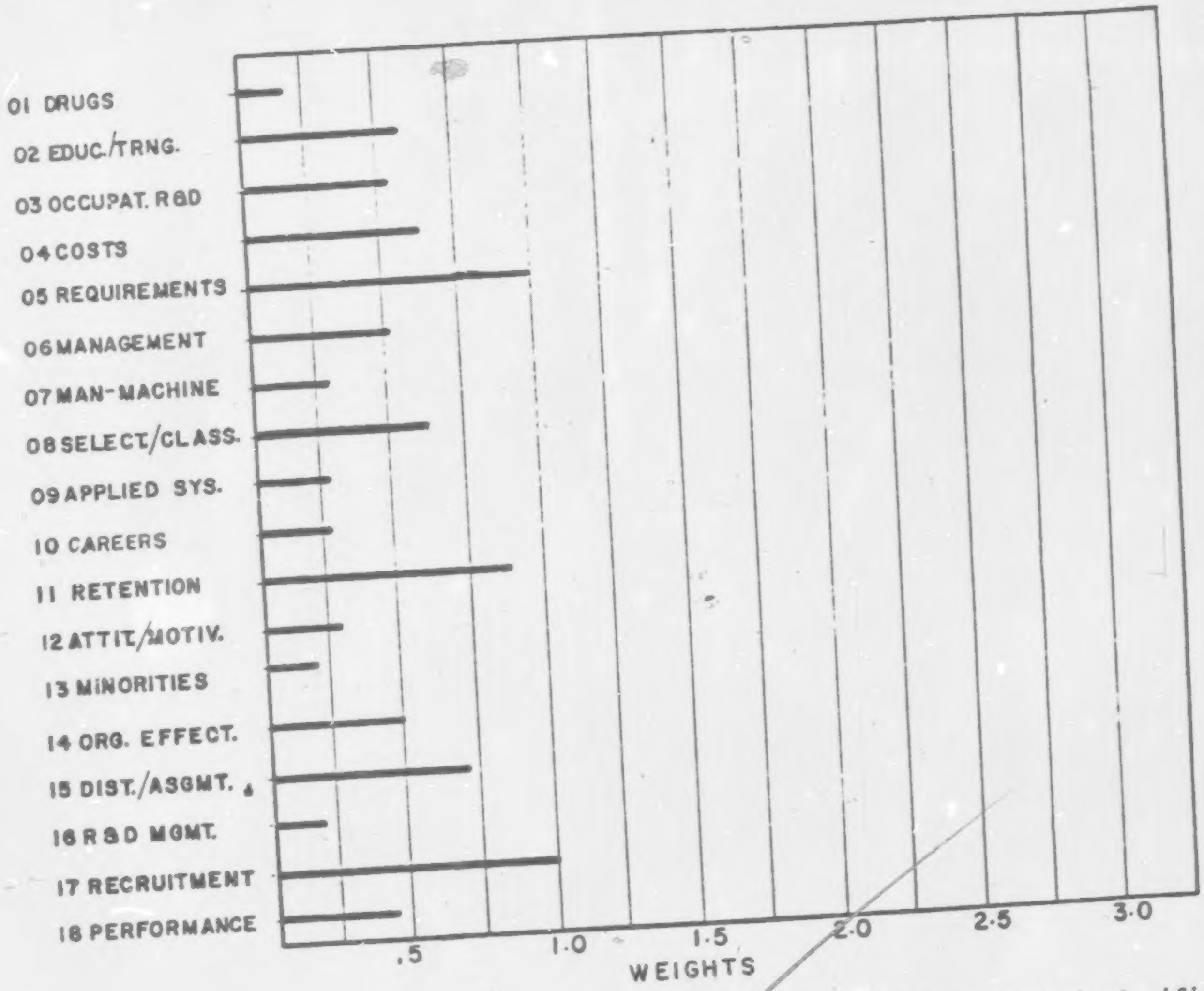

Fig. 3 Relative importance (weights) of program elements on the military significance criterion for the sponsor panel.

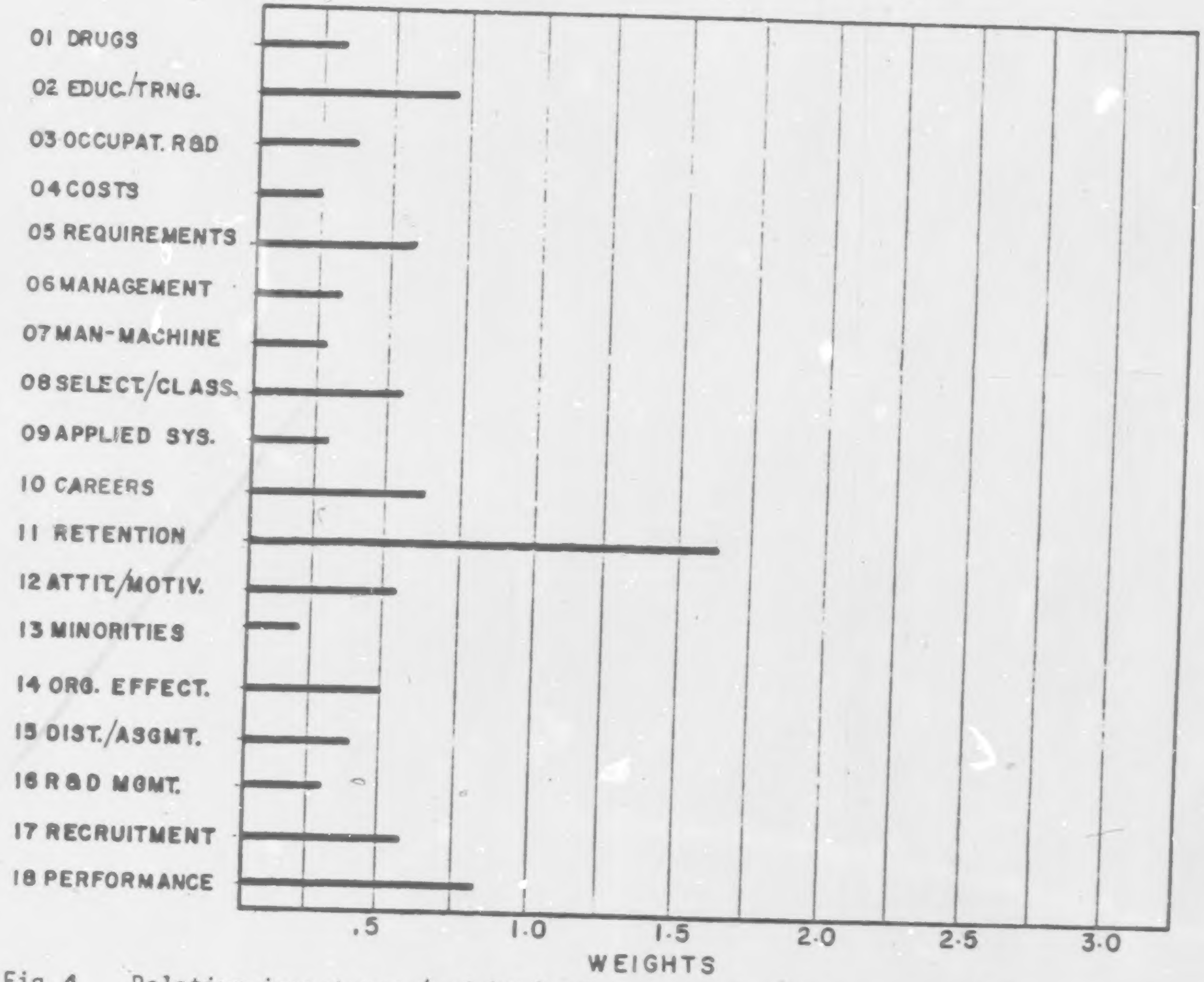

Fig.4 Relative importance (weights) of program elements on the military significance criterion for the user panel.

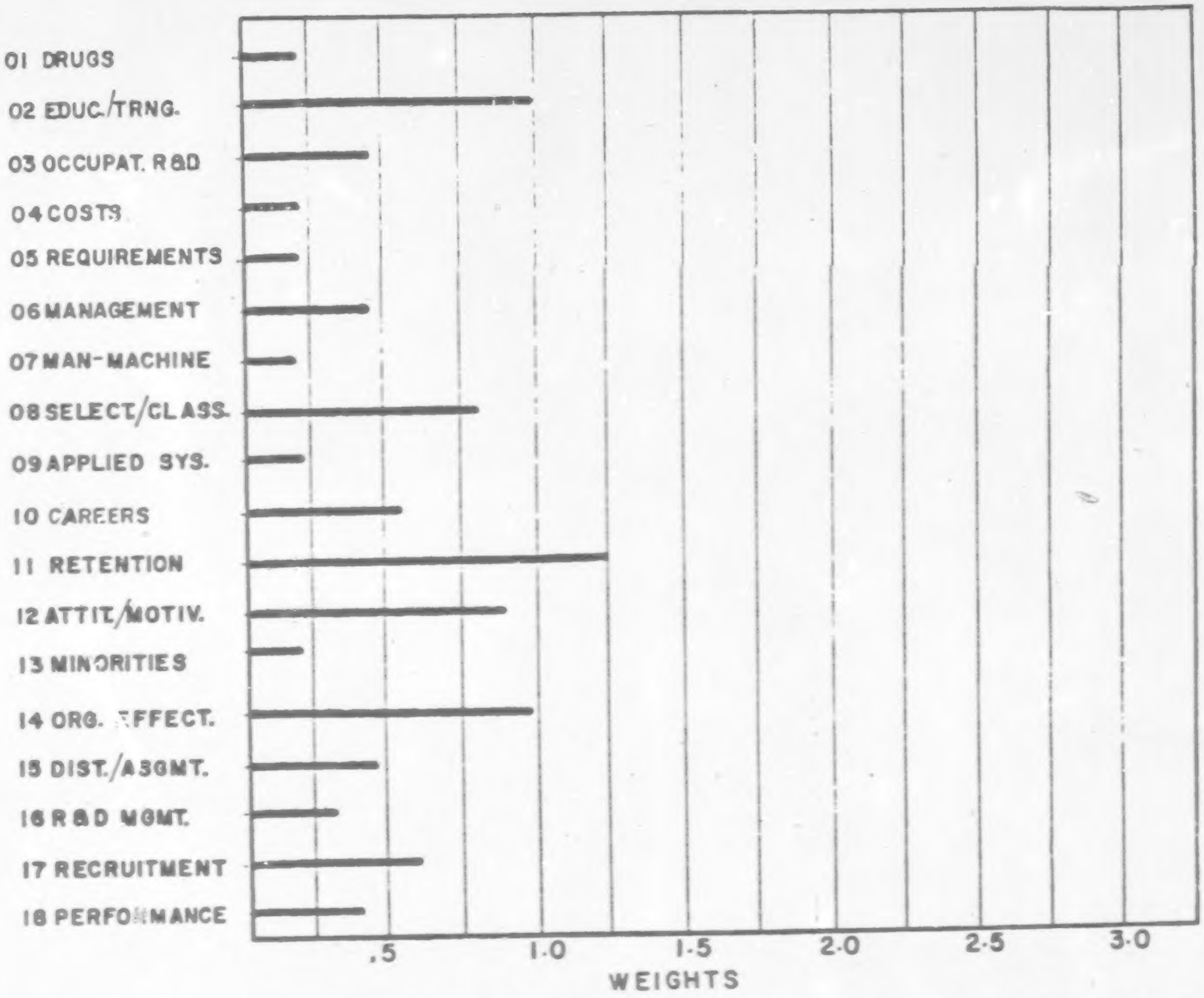

Fig.5 Relative importance (weights) of program elements on the military significance criterion for the NRAC advisory panel.

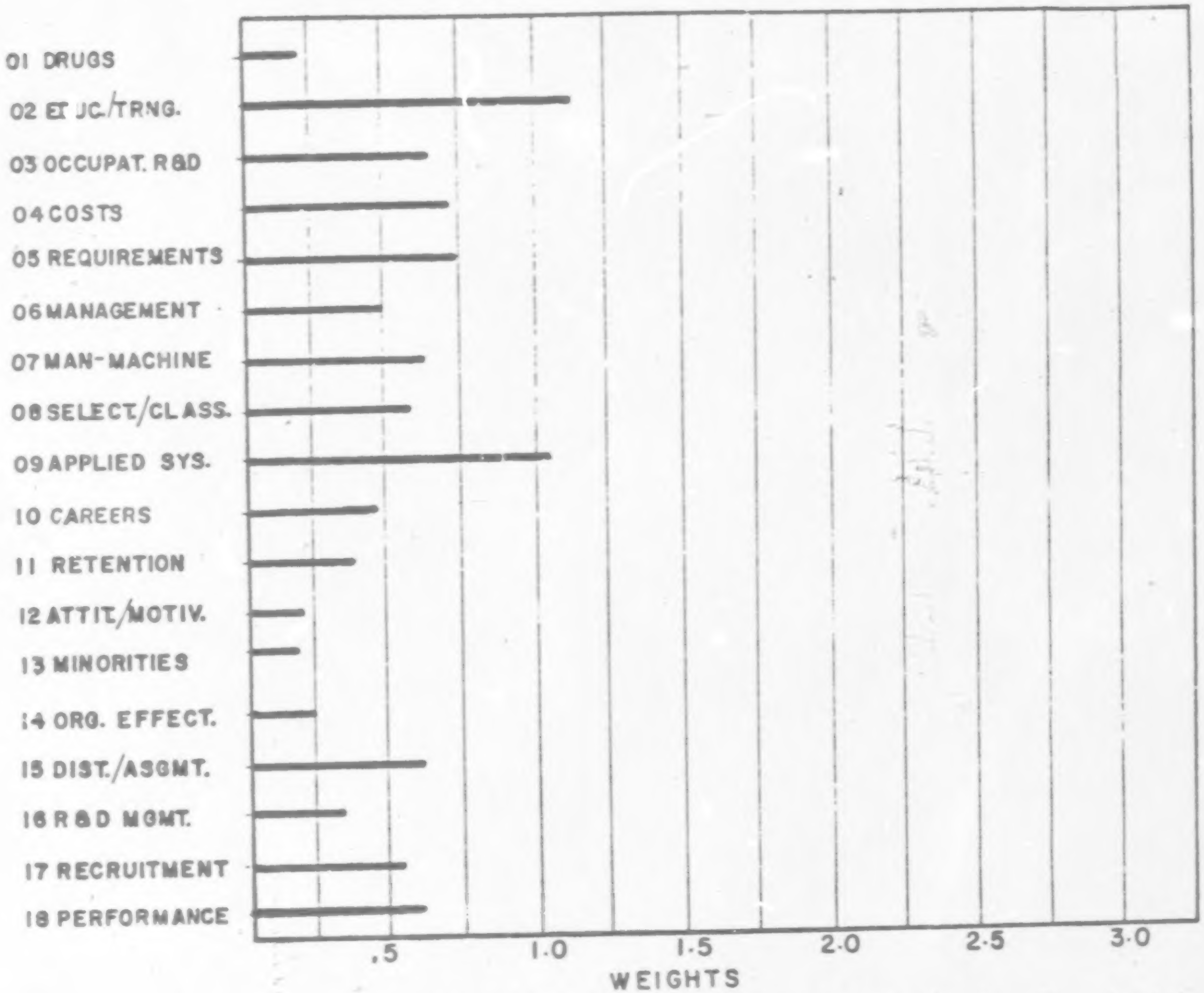

Fig.6 Relative importance (weights) of program elements on the investment risk criterion for all panels.

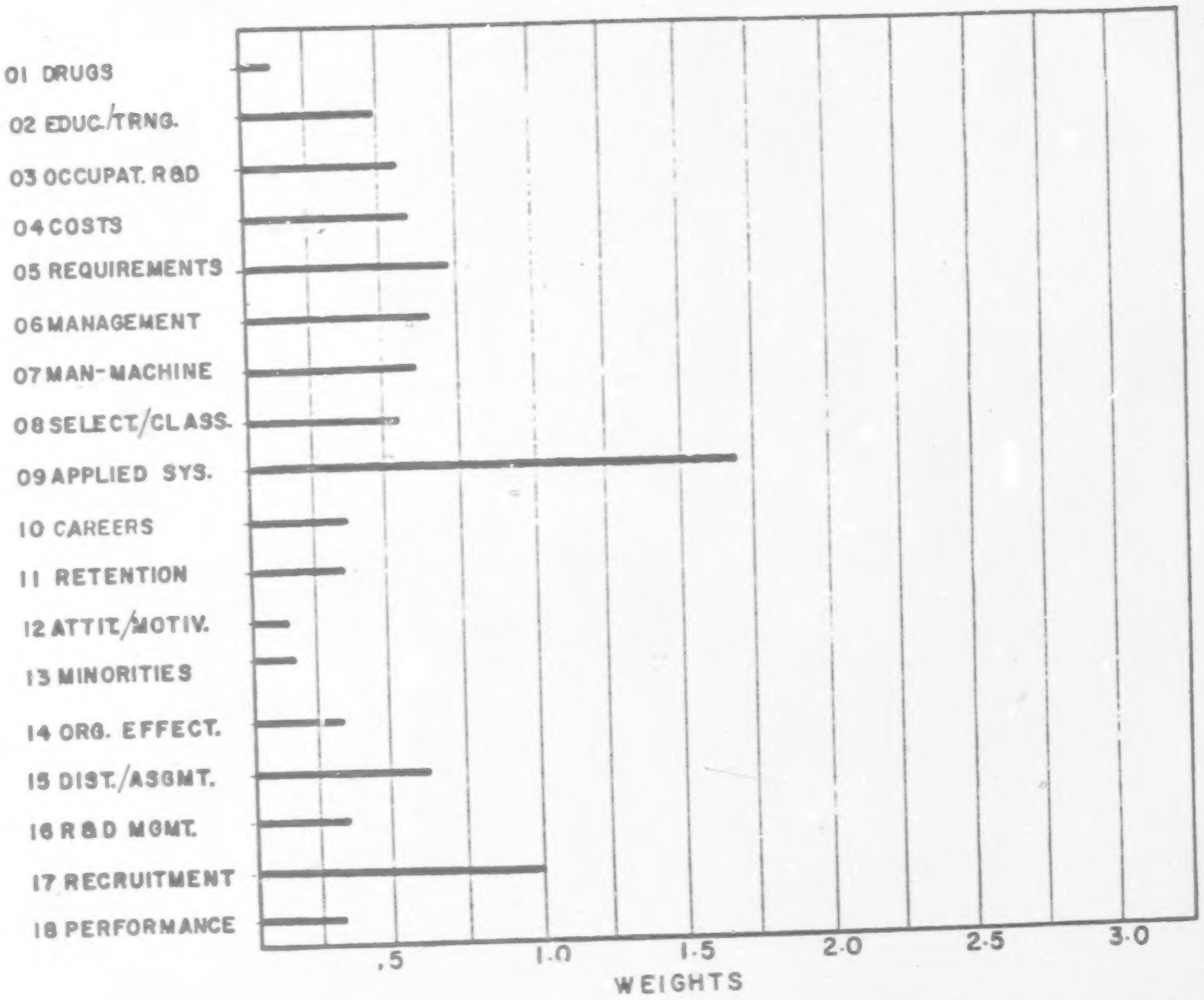

Fig. 7 Relative importance (weights) of program elements on the investment risk criterion for the sponsor panel.

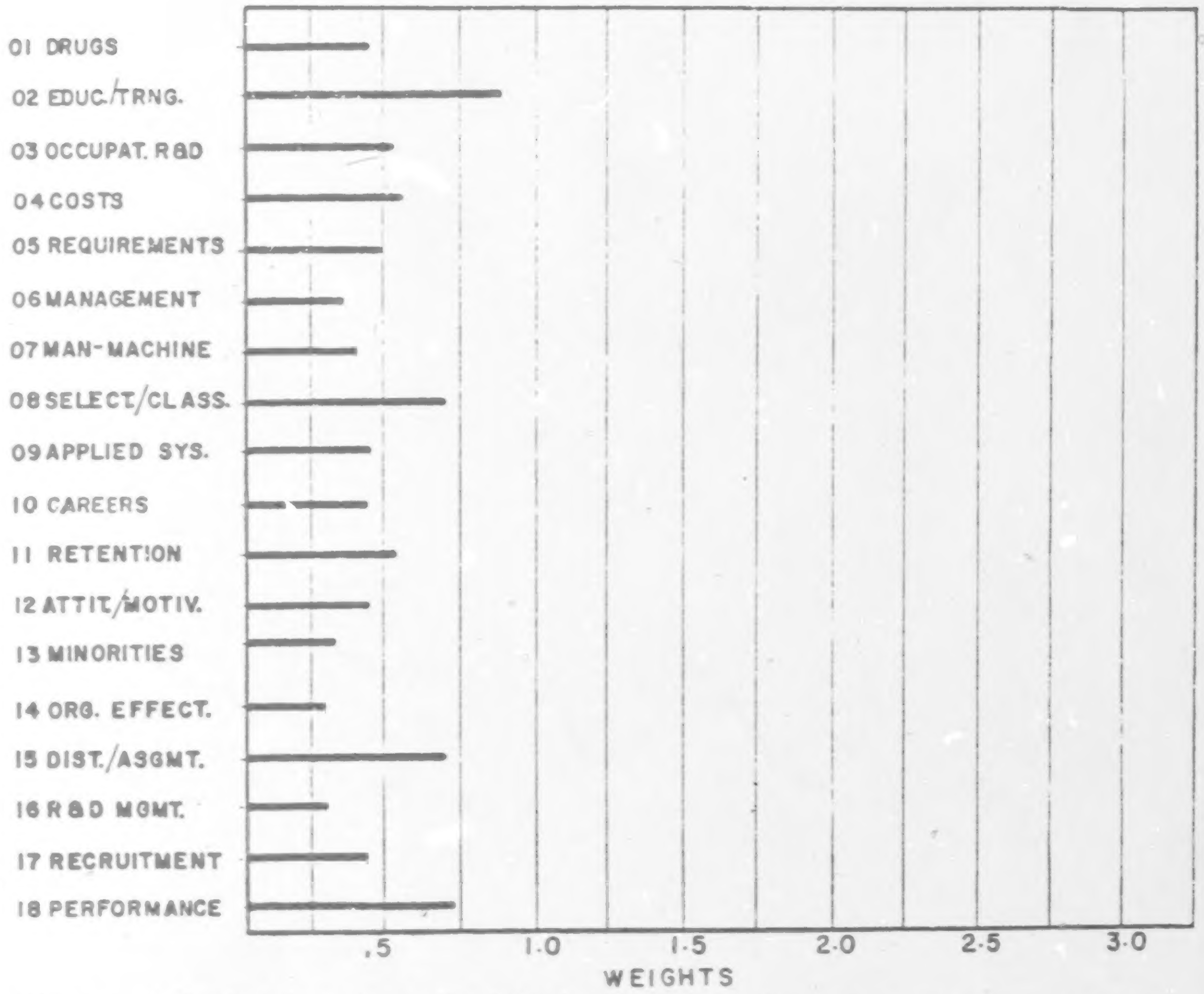

Fig. 8 Relative importance (weights) of program elements on the investment risk criterion for the user panel.

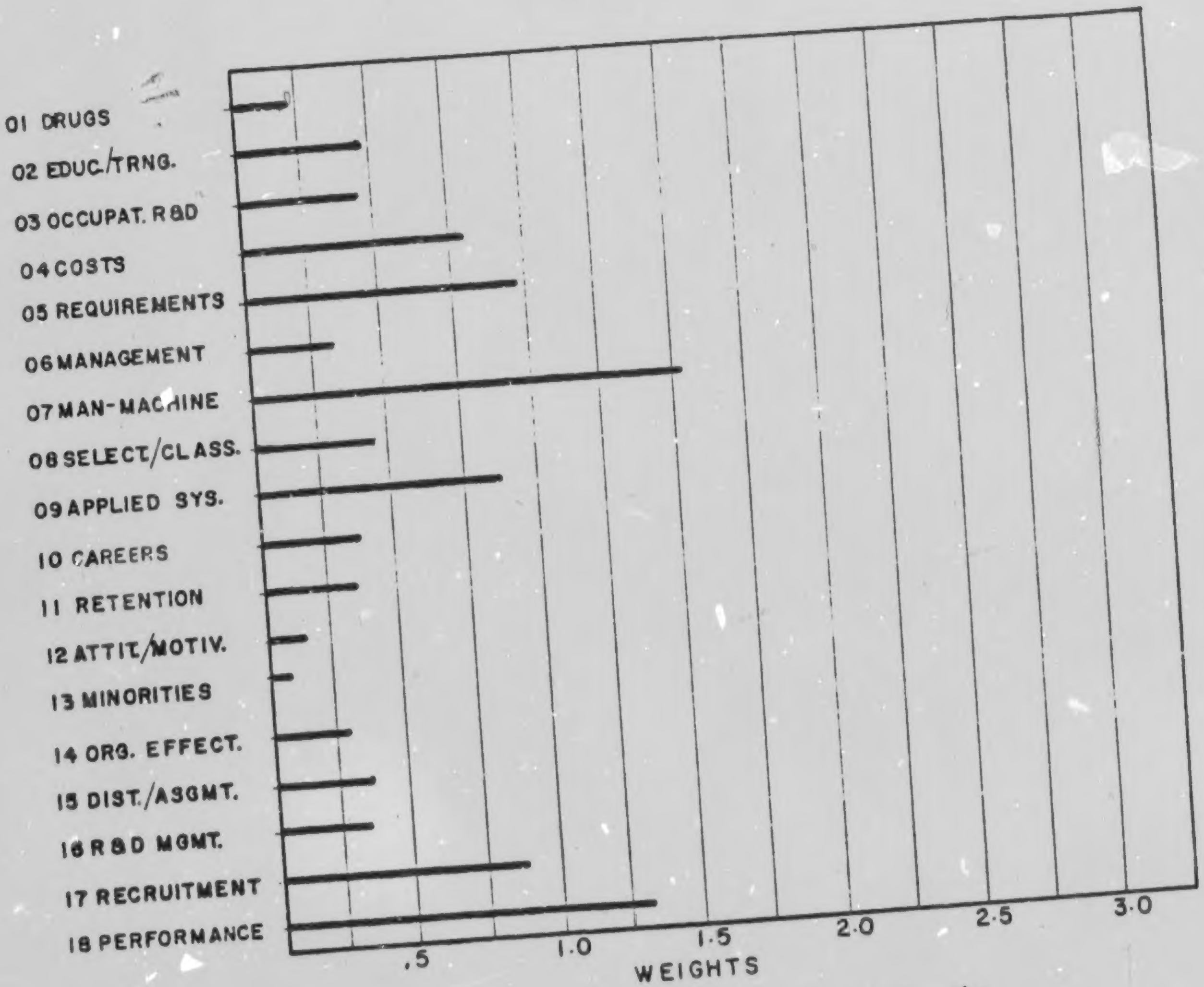

Fig.9 Relative importance (weights) of program elements on the investment risk criterion for the NRAC advisory panel.

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Footnote

1. Invitations to attend the MORS symposia can be obtained from: Military Operations Research Society, 101 South Whiting Street, Alexandria, VA. 22304.

SECTION IV

MOTIVATION AND WORK

Dr. Robert Penn, Chairman

An Overview of Motivation to Work	Dr. Robert Penn
Current Perspectives in Motivational Research	Dr. William Graham
A Research Model for Measuring Motivation: A Suggested Approach	Dr. Sheldon Zedeck

AN OVERVIEW OF MOTIVATION TO WORK

Robert Penn

Introduction

Any conference that focuses on organizational behavior inevitably deals with the topic of motivation in one form or another. In this section, the speakers will address themselves to some of the problems encountered in conducting research on the motivation to work.

I will begin by presenting a brief overview of some of the current theories of motivation that are pertinent to organizational behavior.

Dr. Graham will evaluate the "state of the art" by discussing the validity of current theories, whether they work, and if not, why not? He will also discuss the difficulties of conducting research on motivation to work and will present some research ideas that he thinks organizations should be doing.

Dr. Zedeck's paper will focus on normative vs. ipsative models of measurement, and present some new approaches regarding the use of regression analysis as they apply to motivational research.

The choice of the topic, "Motivation to Work," stems from an interest in the subject. An ever increasing effort on the part of psychologists has been directed at establishing the relevance of motivational theories to work behavior.

It is the opinion of some that a considerable portion of this activity has been spurred by management's apparent concern with improving the quality and quantity of work through changes in worker motivation. Changes in management's attitudes to workers that have occurred in the last 20-25 years can be attributed to the efforts of psychologists.

Definition of Terms

I have always been impressed with the confusion that exists regarding the meaning of the concept of motivation. The definition I feel most comfortable with is one provided by Marshall Jones at the 1955 Nebraska Symposium on Motivation: "... how behavior gets started, is energized, is sustained, is directed, is stopped, and what kind of subjective reaction is present in the organism while all this is going on." This, being one of the broadest definitions I have read, thereby enables us to incorporate for our discussion almost any theory. Others, such as Bandra, focus on the goal-directed aspects of behavior, and still others have concentrated their efforts to the energizing and directing aspects of an individual's actions. Regardless of the definition one accepts, we still must concern ourselves with the variables that affect the behaviors we are interested in investigating.

Another concept that needs defining is that of work. An acceptable definition of work is that developed by Vroom (1964) where he substitutes "work role" for the term "work". "A work role is defined as a set of functions to be performed by a role occupant, the performance of which contributed to the production of goods and services." To which I would add, "and for which compensation is derived".

Job Satisfaction and Work Motivation

While it is not the purpose of this session of the conference to dwell on the relationship between job satisfaction and motivation to work, the two topics appear inextricable. Prior to Brayfield & Crockett's (1955) review of attitudes and performance, it was generally regarded that satisfied workers were more highly motivated than non-satisfied workers, and therefore it followed that satisfied workers would be more productive. The Brayfield and Crockett review was revealing in that no clear-cut statement could be made regarding one's attitude toward his work and consequent performance. This conclusion leads to an ever greater effort on the part of researchers to bring clarity to this area of concern.

Recently it was reported (Lawler, 1970) that there have been at least 5000 studies in the literature that were concerned with job attitudes and that most of these were focused on job satisfaction. The purpose here is not to discuss the controversies that have arisen regarding the measurement of job satisfaction and the fact that the relationship between job satisfaction and motivation is far from being clearly understood, but rather to point out that until this problem is clarified, the contribution of studies of job satisfaction to understanding work motivation will be negligible.

Motivational Theories

In attempting to assess the relationship between motivation and work, one immediately becomes impressed with the lack of unanimity among psychologists in presenting their respective positions. The following questions were posed by Gardner Lindzey (1958) that he felt required resolution before any real progress could be made in resolving differences among theorists. They appear as germane today as when they were written.

a. How important are conscious as opposed to unconscious motives in understanding human behavior?

b. What is the relative importance of direct as opposed to indirect techniques for assessing human motives?

c. Is it essential, in assessing motives, to provide some appraisal of the ego processes, directive mechanisms, or cognitive controls that intervene between the motive and its expression?

d. In assessing human motives, how important is it to specify the situational context within which the motives operate?

e. How necessary is knowledge of the past in the assessment of contemporary motivation?

f. At this time is the area of motivation more in need of developing precise and highly objective measures of known motives or identifying significant new motivational variables?

g. In attempting to understand human motivation is it advisable at present to focus upon one or a small number of motivational variables, or should an effort be made to appraise a wide array of variables? Do multivariate techniques of analysis have an indispensable contribution to offer to the study of human motivation?

h. What is the relative importance of detailed studies of individual cases, compared to carefully controlled experimental research and large-scale investigations?

i. Is there a unique and important contribution to the understanding of human motives that can be made at present through the medium of comparative or lower-animal studies which cannot be duplicated by means of investigations utilizing human subjects?

In light of all the difficulties one has in answering or dealing with the foregoing questions, perhaps one should follow the dictate of George Kelly's (1958) notion that the concept of motivation be repudiated. Even if one were to agree with Professor Kelly, who in the same article dealt with these nine questions by refuting their relevance or appropriateness to the study of human behavior, the concept of motivation appears permanently implanted in psychological repertory and theories of motivation continue to come forth.

One of the best reviews of motivational theories can be found in Campbell, Dunnette, Lawler and Weich's book, Managerial Behavior, Performance, and Effectiveness (1970). A unique part of this review is the classificatory scheme derived by the authors in dividing theories into two groups:

a. mechanical or process theories;

b. substantive or content theories.

Mechanical or process theories attempt to describe the how of motivation, i.e. how behavior is energized, directed, etc. According to Campbell et al., process theories attempt to define the important variables and how they interact.

Content theories, on the other hand, are more concerned with what there is about a person or his environment that motivates behavior. In this sense they are, in some respects, related to what many of us have referred to as personality theories, although content theories also attempt to identify the variables that motivate behavior. The authors of this classification scheme acknowledge that the two groups are not always mutually exclusive.

Process Theories

The best known of the process theories are the S-R-reinforcement theories, best exemplified by the work of Clark Hull (1943) and his followers and the advocates of cognitive theories of behavior reflected in the early work of Tolman (1932) and Lewin (1938). Both of these theoretical positions have their basis in a form of hedonistic thought. The principle of reinforcement, which is the cornerstone of most S-R theories, has contributed much to psychologists' ability to predict and alter many behavioral outcomes. At the same time, the cognitive psychologists did not place as great an emphasis on the principle of reinforcement. Most cognitive theorists placed greater emphasis on the goal-directed aspects of behavior and where one's choices were not as dependent on historical antecedents of the individual. There are, of course, other differences between the two approaches, which are not dealt with here. The theories that have been most fruitful in generating research in Organizational Psychology are primarily those propounded by the cognitive theorists. Cognitive theorists who have dealt specifically with the work environment are:

Instrumentality Expectation Theory: Vroom (1964), Porter & Lawler (1968)

Galbraith & Cummings (1967, Graen (1969)

Balance Theory: Korman (1970)

Equity Theory: Adams (1963)

The basis for the work of these approaches can be found in the reports of Peak (1955), Rotter (1955), Geoupoulis et al. (1957), Atkinson (1958), Tolman (1959), and Homans (1961). Briefly, the major propositions stated by these theorists are as follows:

Vroom

a. The valence of ~~an~~ outcome to a person is a monotonically increasing function of the algebraic sum of the products of the valences of all other outcomes and his conceptions of its instrumentality for the attainment of these other outcomes.

b. The force on a person to perform an act is a monotonically increasing function of the algebraic sum of the products of the valences of all outcomes and the strength of his expectancies that the act will be followed by the attainment of these outcomes.

Valence, then, refers to preference toward specific outcomes, positive or negative. Expectancy refers to the likelihood that an act will be followed by an outcome. Saying it another way, the valence (preference) for attaining a first level outcome depends on his subjective estimate of the consequences of this outcome (second level outcome) and how attractive or unattractive these second level outcomes are.

Vroom sees the application for this theory in the area of occupational choice, job performance, and job attrition and job satisfaction. Essentially, then, Vroom postulates two models. Mitchell and Biglan (1971), in their Psychology Bulletin review of instrumentality theories, referred to the valence portion as a job satisfaction model, essentially because the model says that an individual's satisfaction with his job results from the instrumentality of the job for attaining other outcomes and the valence of those outcomes. Mitchell and Biglan refer to Vroom's second model as the job performance model since the individual's expectancy is defined by Vroom as his belief concerning the probability that the behavior in question will be followed by the outcome of interest, with the expectancy interpreted as a perceived probability ranging from 0 to +1. It is distinguished from instrumentality in that it is an action--outcome association while instrumentality is an outcome--outcome association.

Vroom's model has been tested by Galbraith and Cummings (1967), Porter and Lawler (1968), Hackman and Porter (1968), and Graen (1969). Porter and Lawler differ from Vroom by the introduction of moderator variables in the form of ability and role perception in describing the relationship between effort and performance. Over all, their work has resulted in moderate success.

Graen (1969) extended Vroom's theoretical approach by differentiating between first and second level outcomes, as the first level outcome is called a work role, while second level outcomes are called role outcomes that occur because of successful completion of work roles.

The most thorough test of an instrumentality theory has been reported by Jorgenson et al. (1973). In general, the results, while interesting and somewhat corroborating of the general theory, have been disappointing. Correlations (usually multiple) were significant but low. Possible reasons for this are:

a. a priori outcomes may not be complete or relevant;

b. interaction effects of outcomes not measured:

c. extent to which individual has control over his own behavior;

d. performance (first level output) measures may not be dependent on individual's effort.

There are some specific criticisms of expectancy theory that will be dealt with later by Dr. Graham.

Equity Theory

Equity theory has been formulated most thoroughly by J. S. Adams (1963, 1965) and most authors tend to associate it with his name. For those interested in a more complete understanding, refer to Pritchard's (1969) review in Organizational Behavior and Human Performance. Essentially the theory deals with:

a. a worker's inputs and outcomes;

b. a process of social compensation;

c. conditions leading to equity or inequity and their effects;

d. reactions to conditions of inequity.

Inputs involve everything a person perceives as significant for getting something in return for his investment.

Outcomes involve what a person gets for his investment that is significant to him.

Paraphrasing Pritchard, "Equity is said to occur when an individual (person) interprets the ratio of his Outcomes to Inputs as equal to someone else's (a relevant other) O-I ratio.' Inequity results when:

a. person and other are on a one-to-one basis (direct exchange);

b. when both are involved with a third party (employer).

When inequity exists, according to Adams, (depending on whether he is underrewarded or overrewarded) a person will try to bring about a condition of equity by:

a. changing his inputs or outcomes;

b. changing the comparison other;

c. getting the other to change;

d. distorting what he perceives.

While there are many problems raised by this theory that require resolution, nevertheless, the hypotheses are testable, and though the literature yields equivocal results, it appears as a way of dealing with one's perception of his pay and its effects on performance.

A comparison of predictions made by equity theory with those of expectancy theory has been dealt with by Lawler (1971). He points out that equity theory would predict that when one changes the amount of pay that a person receives, that this change in pay will affect motivation. Expectancy theory makes no prediction unless the amount of pay is seen as dependent upon job performance. One other major difference is that expectancy theory predicts that increase in the reward size should lead to increased motivation to act in whatever way leads to the reward. Equity theory would predict just the opposite, especially in the piece-rate situation where pay depends on productivity. Finally, equity theory is unique as a process theory in that the central theme is that the only motivations of an individual that are considered are those involved in a comparison process with someone else.

One other process theory that has been developed for work behavior is the "balance" or "consistency" theory put forth by Abraham Korman (1970) which emphasized self-evaluation and self-perception as well as conceptions deriving from past reinforcements. In this sense it is historical as well as ahistorical. The basic hypothesis is as follows: "All other things being equal, individuals will engage in, and find satisfying, those behavioral roles which will maximize their sense or cognitive balance or consistency." Korman then presents the derivations that would be implied from the above hypothesis:

a. Individuals will be motivated to perform on a task or job in a manner which is consistent with the self-image with which they approach the task or job situation. That is, to the extent that their self-concept concerning the job or task situation requires effective performance in order to result in "consistent" cognitions, then, to that extent, they will be motivated to engage in effective performance.

b. Individuals will tend to choose and find most satisfying those job and task roles which are consistent with their self-cognitions. Thus, to the extent that an individual has a self-cognition of himself as a competent, need-satisfying individual, then, to that extent, he will choose and find most satisfying those situations which are in balance with these self-perceptions.

Korman goes on to cite the kinds of research evidence that are supportive of this hypothesis, developed by his own work and that of others. For example, Aronson and Carlsmith (1962) who found that when a person's performance is too high for his self-conception of his ability, he will try to decrease his performance in order to match his self-conception. He interprets the Adams and Rosenbaum (1965) study of equity theory, that individuals who have too high reward made contingent on their behavior will adjust their behavior in order that outcomes will be at a lower, more appropriate level. It thus seems that the predictions of equity theory can be incorporated under this notion of balance and consistency. Korman provides some experimental evidence of his own which is somewhat supporting of the basic notion. A key element to the theory obviously rests on the manner in which one's self-conception, or putting it another way, how one's self-esteem is measured or manipulated, particularly when one is dealing with work behavior.

As mentioned earlier, SR reinforcement theories have generally not been as well accepted among industrial psychologists nor management personnel generally. This is surprising when one considers that the impact of reinforcement principles, particularly as espoused by Skinner and other operant psychologists, are at the forefront in fields of academia, therapy, child rearing practices, and classroom learning. While there are no definite answers as to the failure of operant psychologists to have a greater impact on the world of organizational behavior, it would appear that one of the reasons would be the development of humanistic psychology in industry that occurred as a reaction to the proponents of what has come to be known as "Taylorism" which followed more closely in lines of traditional thinking of rewards and punishment. Within this framework of thinking, one can deal more adequately with affective aspects of behavior that are not specially pertinent to reinforcement psychology. Thirdly, industry has always been somewhat behind the Zeitgeist that has occurred in academic circles, and perhaps the decade of the 80's will find the use of operant techniques more in the forefront. Lastly, cognitive psychologists have faced up to the problems of alienation and boredom that appear to confront many workers, whereas reinforcement theorists, for the most part, have not addressed themselves to these issues. It is this latter point that is most significant. If the theories of reinforcement are to have any bearing or impact on problems of organizational behavior, then they must address themselves to these issues.

Content Theories

Of the various content theories that have been developed, only a few have had relevance for organizational behavior. The names of Maslow (1954) and McGregor (1960) rank at the top of those whose theoretical formulations have been most widely accepted by industrial leaders. Maslow's basic theory postulates a set of psychological needs that develop in a hierarchy from lowest to highest as follows:

a. physiological needs;

b. safety needs;

c. social needs;

d. esteem needs;

e. self-actualization.

Essentially, the theory suggests that as the lower-order needs are satisfied, an individual's higher-order needs become the motivating force, and that only to the extent that an organization can provide individuals with opportunities of satisfying these higher-order needs will the behavior of an individual be conducive with management's expectations. This is true, according to Maslow and followers, inasmuch as the lower-order needs, physiological and safety, have been fairly well taken care of in our society.

McGregor develops what he calls Theory Y, in contradiction to Theory X, based on Maslow's motivational theory to account for work behavior. Theory X, according to McGregor, is the conventional managerial position that proposes to deal with human behavior, based on assumptions about the nature of man being indigent, lacking ambition, inherently self-centered, disliking responsibility, and not very bright. The managerial scheme that would follow would place in management the responsibility for organization, direction, and control in motivating the behavior of people in the organization to satisfy the needs of the organization One controls this behavior by persuasion, reward, and punishment.

Theory Y, on the other hand, is based on Maslow's needs, and the goal of management then would be where, ". . .the motivation, the potential for developing the capacity for assuming responsibility, the readiness to direct behavior toward organizational goals, are all present in people. Management does not put them there. It is the responsibility of management to make it possible for people to recognize and develop these human characteristics for themselves, and the essential task of management is to arrange conditions and methods of operation so that people can achieve their own goals best by directing their own efforts to organizational objectives, essentially a process of creating purpose, releasing potential, and removing obstacles." Probably familiar to most management people in the sense of creating conditions of "Management by Objectives." Ways in which Theory Y can be implemented are through some notions of decentralization, delegation of responsibility, job enlargement, participation in the decision process, and through performance appraisal.

A considerable amount of literature is available attesting to the value of Maslow's Theory. Yet I am aware of very little supporting research evidence. With the exception of work by Chris Argyris, I am aware of no studies conducted in an industrial or business context that are supportive of Maslow's need theory. Yet so much of what occurs in the field of management training is predicted on the validity of this approach.

Herzberg's (1959) 2-factor theory postulates that the factors responsible for motivation are those intrinsic to the job itself, namely achievement, recognition, responsibility, opportunities for advancement. The extrinsic factors or hygienic factors such as pay, supervision, human relationships, company policies, working conditions, and job security, are not important in terms of energizing, sustaining or directing one's efforts, but are concerned with the prevention of job dissatisfaction. The intrinsic factors or motivators have no influence on job dissatisfaction, but operate only to increase job satisfaction. Most of the research surrounding Herzberg's 2-factor theory has been concerned primarily with the factors as they contribute to job satisfaction or dissatisfaction, and not to the role of intrinsic factors serving as motivators. Without going into details, I tend to view Herzberg's notions as oversimplifications of human behavior and as, in many instances, highly irrelevant to an appropriate understanding of motivation.

One final content theory stems from the work of McClelland and Atkinson, more particularly McClelland. In his study of enterpreneural behavior, McClelland (1961) makes the distinction between such behavior and the behavior of entrepreneurs, who he defines as someone who exercises some control over the means of production and produces more than he can consume in order to sell it for income. McClelland's investigation demonstrates a significant relationship between the level of entrepreneural activities and the degree of economic growth attained during the particular period that was studied.

Basing his work on Maslow's need theory, data are presented to support the notion that individuals who are high in need for achievement (*n ach*) tend to be more likely to be engaged in occupations of an entrepreneural nature than those who are lower in *n ach*. Such individuals also, according to McClelland, tend to be moderate risk takers, innovators, and assume greater responsibility. Since the methods used by Murray, namely the TAT, also measure need for power (*n p*) and need for affiliation (*n aff*), McClelland also hypothesizes that the high acieving individual will also possess high *n p* and low *n aff*. I am not aware of many studies that have attempted to relate *n ach* to performance except those that tend to show that individuals in executive positions tend to have higher *n ach* scores than those lower on the managerial hierarchy. There appears to be, in the popular literature, a desire for capitalizing on individuals with high need for achievement. The researchers are not in a position at this time to show that individuals with high *n ach* scores are more likely to have higher levels of motivation than individuals with low *n ach* scores.

The content theories, in general, postulate a need system that views man as a creature with aspirations toward angelhood that are prevented from fulfillment due to the restrictive nature of the environment in which he works, and that if only we could recognize this, we could then redesign the organizational structure, redesign jobs, allow individuals to have greater mastery over the decision-making process, etc., and thus approximate a new Utopia of work. This notion about the nature of man, in my opinion, is much too simplistic, for it ignores what many psychologists have deemed a significant motivational force, namely fear or anxiety. It ignores, also, the need for power that many individuals apparently possess and, in general, fails to recognize diverse theories that deal with man's behavior. Specifically, I refer to some of the personality theories that have evolved over recent years which, while they have not directed their attentions specifically toward work behavior, some have developed notions that can, in general, subsume most of the ideas put forth under content theories of motivation described here. I refer specifically to the early work of Solomon Diamond (1957), who developed a notion of temperamental dispositions of affiliativeness, aggressivity, fearfulness, and impulsivity as the basic underlying dimensions of temperament that evolve into the complex personality structure that one finds in an adult.

I have not attempted to relate the large number of empirical studies that have attempted to correlate significant variables (such as pay, job design, leadership) with performance measures that have been used to support or negate the various theories. These will be covered in the remaining part of our conference.

Researchers have come a long way in industrial psychology from the time when the cry was that no theoretical work exists in the field, but rather a massive collection of empirical data that had little if any generalizability. Those who feel that there have been too many theories developing in the last few years and not enough empirical evidence in support of them will, in the future find their concerns minimized, as historically, theories of validity survive and develop their usefulness, while others may be fashionable at some point in time but without supporting empirical evidence tend to fall in disrepute. Perhaps a conference on Motivation to Work that occurs in the 1980's will show which of today's currently fashionable motivational theories are worthy of survival.

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CURRENT PERSPECTIVES IN MOTIVATIONAL RESEARCH

William K. Graham

Motivation is a topic surrounded by controversy in virtually all areas of psychological research. The intention of this paper is to comment on motivation research and practice within the field of industrial and organizational psychology.

Part of the recent increased interest in motivation among industrial and organizational psychologists stems from the rather controversial view that a new anti-work ethic is emerging in the United States. Newspapers, magazines, and television programs have carried feature articles and documentaries along the general theme that workers are becoming alienated to the point of rebellion. A recent Health, Education and Welfare report concluded that workers are growing restless because of "dull, repetitive, seemingly meaningless tasks, offering little challenge or autonomy." Along these same lines, a frequently cited study by Shepard and Herrick of 400 male union members concluded that one third were so alienated that shorter working hours, longer vacations, or even more money would not help. The work of Kornhauser (1965), among others, implies that certain types of work ought to be put on the Surgeon General's list as injurious to health.

In addition to the nature of the work itself being a cause of alienation, it is often noted that the labor force is younger, better educated than ever, that it contains longhairs and radicals, even some Berkeley students, and that there has been a decline in the proportion of workers who gained their maturity in the shadow of the depression.

While all of this is undeniably true, the changing work ethic hypothesis is grossly overstated. By and large, most of the evidence for the emergence of an anti-work ethic comes from the one million or so urban workers engaged in short cycle, mass production assembly line work in which there is virtually no control over work pace (Walker & Guest, 1952; Blauner, 1960; Kornhauser, 1965; Seashore & Barnow, 1972). This is not to say that the problem is an unimportant one, but its magnitude is at least partially diminished when it is recognized that the labor force contains in addition some 28 million blue collar workers, 41 million white collar workers, and 13 million service and farm workers. The beneficial impact of the changing work ethic hypothesis has been to focus attention on the nature of work, the tasks people are asked to do, and to stimulate thinking about how jobs, the job environment, and work incentives might be redesigned so that people are able to enjoy their work more and do it better.

An older and apparently less controversial hypothesis concerning the motivation of workers has been labeled the personality versus organization hypothesis (Strauss, 1962, 1973). While this hypothesis has been stated in a variety of ways, the common theme is that there exists a basic, virtually inevitable conflict between individual and organizational needs. Elements of this hypothesis can be found in the works of people such as Argyris (1957), Maier (1955), and McGregor (1960). As Strauss (1973) has noted, the underlying rationale for the hypothesis goes something like this:

(1) In their affiliation with an organization, workers seek social belonging, independence, and personal growth. To use Maslow's (1954) terms, workers seek to move up the need-hierarchy from physical through safety, social, esteem, to self-actualization needs. (By "hierarchy" is meant that a higher, less basic need does not provide notivation unless, lower, more basic needs are satisfied, and that once a basic need is satisfied, it no longer motivates.) An important part of his underlying assumption is that these needs must be met on the job.

(2) The control structures in organizations are set up in ways which fail to recognize individual needs and instead are designed according to "Theory X" (McGregor, 1960) assumptions that people are basically lazy, that they dislike work and, when given the chance, will do what they can to avoid responsibility. Acceptance of these assumptions has led organizations to develop methods of supervision and control which force workers to behave in an immature and dependent fashion.

(3) Because they are caught in an inflexible, oppressive system that does not permit the fulfillment of higher order needs, workers become alienated from their jobs. This alienation may be expressed actively through increased union activity, strikes, restriction of output, or even sabotage. Alternatively, alienation may be expressed in relatively passive ways through withdrawal, lack of interest, or an unwillingness to do anything more than meet the minimal requirements of work. In any case, the response of the Theory X organization is to tighten up its control system, to supervise more closely. As a result, workers become even more frustrated and the likelihood is increased that they will work against the organization rather than for it.

(4) Finally, the personality versus organization hypothesis suggests that the way to get out of this vicious cycle is to build control systems based on "Theory Y" assumptions. Namely, that given the chance people can enjoy work, that workers can exercise self-control, and that work should be organized in ways that allow people to express their imagination and creative talents. The general prescription is that organizations should promote job enrichment, relaxed, more general supervision, and that they should encourage the development of cohesive, semi-autonomous work groups. This - so the formula goes - will lead to more challenging work, greater intrinsic job satisfaction, and to individual growth.

Admittedly, this presentation of the personality versus organization hypothesis is a grossly oversimplified characterization. It represents a kind of montage of ideas snatched from the human relations movement, the so-called human potential movement, and from what Campbell, et al. (1970) have labeled "content" theories of motivation. However, the characterization encapsulates fairly well the thinking of many recent MBA graduates and organization development specialists.

Content theories of motivation are pretty much in agreement with the personality versus organization hypothesis. Whether one chooses to adopt Maslow's (1954) need hierarchy theory or Herzberg's (1959) line of thinking, the kinds of changes one would strive to make in an organization would be the same. An exception might be McClelland's (1953, 1961) nAch Theory. McClelland's work suggests that individuals differ in their needs for achievement, affiliation, and power. Moreover, evidence suggests that these needs can be altered through training. Thus, McClelland has found that in a relatively short training program, nAch can be increased (and, presumably decreased). While McClelland's work is usually presented as an illustration of how individuals can be induced to desire success and take on challenging tasks, similar techniques might be developed to put up with basically challengeless work. This is not meant to advocate; rather, it is to point out what is seen to be an important difference between McClelland's approach to motivation and the approach represented in the thinking of Maslow and Herzberg.

Among those who accept the personality versus organization hypothesis, and also among content theorists, the tendency has been to blame the environment, specifically the organization for any motivation problems that might exist. It is probably the case, however, that there will always be some workers who even in the best conditions will lack the motivation to work. As Porter and Lawler (1965) have suggested, in arguing that we should focus more attention on the complex interactions between individual difference variables and environmental factors, "Too much previous theorizing in the area of organizations has neglected . . . interaction possibilities and hence, there has been an unfortunate tendency to oversimplify vastly the effects of particular variables. Organizations appear to be much too complex for a given variable to have a consistent unidirectional effect across a wide variety of types of conditions (p. 48)."

Lichtman and Hunt (1971) in summarizing the utility of content type theories concluded: "The virtue of the one-sided versus the eclectic approach depends in part on the purpose of the theorist. If his purpose is to convince bureaucratic managers of the advantages of human relations practices, there is probably no harm in taking a more extreme personalistic view of human behavior in organizations. If, however, the theorist's intent is to build an accurate and workable general model of organizational functioning, then it is clear that none of the one-sided (content approach) views proposed to date can do that job (p. 282)."

Herzberg's (1959) two-factor theory, although not clearly a theory of motivation, deserves special comment. As Campbell, et al (1970) have indicated, ". . . the two-factor theory has been argued with a good deal of eloquence and also presents a manifestly simple hypothesis to test, it has stimulated a great deal of research (p. 380)." Of course one reason it has stimulated so much research is that behind the eloquence and surface simplicity one finds a good deal of latent complexity and confusion. King (1970), for example, has pointed out that at least five distinct versions of the two factor theory have been stated or implied in the literature. Thus, the two-factor controversy, which has generated considerable negative evidence and almost an equal amount of support, is overshadowed by the vague and sometimes different interpretations of the theory by various researchers. In a recent study, Waters and Waters (1972) tested all five of the versions of two-factor theory outlined by King and failed to find support for any version.

Let us turn now to theories of motivation which emphasize process rather than content. Namely, equity theory (Adams, 1963, 1965), expectancy theory (Vroom, 1964) and social learning theory (Bandura, 1969, 1971).

According to Adams (1965) people experience inequity when they perceive that the ratio of their outcomes to inputs differs from the outcome-input ratio of others with whom they compare themselves. This may occur when they are in a direct exchange relationship with comparison persons or when they and their comparison persons are in an exchange relationship with a third party (p. 280). Outcomes may include such things as pay, fringe benefits, status, etc. Inputs include how hard the person works, educational level and general qualifications. The relation that determines the inequity of any particular input-outcome balance is the person's perception of what he is giving and receiving even though this perception may not correspond with the perception held by others. The theory stresses that the presence of inequity will motivate a person to achieve balance or to reduce inequity and that the strength of the motivation to restore equity will vary directly with the perceived magnitude of the inbalance between input-output ratios. Research in the area of equity theory has dealt primarily with compensation practices, particularly with how quantity and quality of work are affected when people feel that they are being underpaid or overpaid.

Equity theory is a good deal more complex than one might initially think. Weick and Nesset (1968) have listed six ways that perceived input-outcome ratios can lead to feelings of inequity. To these let us add two more which, so far as it is known have not been treated in the literature. Both involve cases of inverse ratios. For example, it seems reasonable that a person would experience inequity if he perceived his inputs to be low and his outcomes to be high when the comparison other is seen to experience the opposite, i.e., low outcomes with high inputs. Similarly, if the individual views his inputs as high and experiences low outcomes when the comparison other is seen to have low inputs and high outcomes, I suspect there would be feelings of inequity.

Equity theory is closely related to social comparison theory and dissonance theory (Festinger, 1954; 1957) and, not surprisingly, it suffers from some of the same problems. Very little is known about the degree to which people differ in their tolerance for inequity. Moreover, the theory fails to specify how people select comparison persons. However, if people do in fact strive to reduce inequity, there might be a tendency to select people who have a similar input-output ratio. Laboratory studies of equity theory have generally been set up in ways which restrict the selection possibilities to those which lead to inequity.

IV-2.4

Among the process theories of motivation, expectancy theory has received the greater attention by industrial and organization psychologists. Historically, the theory may be traced to the work of Tolman (1932) and Peak (1955). It is also closely related to subjective expected utility theory in the area of decision making. The prominance of expectancy theory in industrial and organizational psychology is due to the work of Vroom (1964) and Porter and Lawler (1968). Critical evaluation and elaborations of expectancy theory, which also goes under the name of path-goal or instrumentality theory, have been presented in recent papers by Heneman and Schwab (1972), Graen, (1969), and Mitchell and Biglar (1971). The basic notion in expectancy theory is that the expenditure of energy is a joint function of a person's subjective expectancy that his behavior will lead to particular outcomes and the value he places on those outcomes. If, for example, a worker places a high value on money and also perceives that the probability of obtaining money is linked to the number of widgets he produces, other things being equal the likelihood is increased that he will in fact turn out more widgets. Unlike content theories of motivation, expectancy theory makes no assumptions about the specific needs people strive to fulfill. The theory allows for individual differences in the kinds of needs, the number of needs, and perceived links between rewards and needs. An advantage of expectancy theory is that it suggests different methods for modifying behavior. For example, according to the theory, behavior can be changed by altering perceptions of the link between behavior and outcomes or by influencing the perceived value of outcomes.

In spite of these advantages, expectancy theory does have its problems. One problem has to do with the independence of the desirability of rewards and the perceived probability of obtaining them. While theoretically it is possible to think of these as being independent they may be psychologically dependent, and perhaps more so in some individuals than in others. People do seem to differ in the degree to which they engage in wishful thinking. Thus, there is some evidence that one can predict behavior merely by summing the expectation component of the theory leaving out the probability judgments. What may be happening is that in paper and pencil tests of the theory, expectations become modified by probability judgments in the heads of subjects before they are recorded on questionnaires.

A second problem is not so much a criticism of the theory as it is a general fault of the methods used to test it. Although expectancy theory suggests that the number and kinds of expectancies may vary from one person to the next, the common research practice is to provide subjects with a list of possible rewards together with some scales for making desirability and probability judgments. While this is a convenient research practice, it does not constitute a proper test of the theory and actually amounts to a crude form of averaging where there should be summation.

This brings us to a third problem, namely the question of whether it makes theoretical sense to sum the products of reward values and their probability of occurrance. To do so suggests that the rewards are independent; that each makes a unique contribution to energy expenditure. There are doubts about this assumption but whether it is of practical significance is a question for future research.

IV-2.5

Finally, discussions of expectancy theory in the literature tend to adopt an almost exclusively normative approach involving the comparison of absolute levels of values attached to rewards by different groups or classes of workers. However, expectancy theory suggests that one should look at the relative values attached to rewards by individual subjects. A procedure for investigating this question is discussed in Professor Zedeck's paper.

These problems notwithstanding, if I were pressed to choose among the prominent theories within the field of industrial and organizational psychology I would, without hesitation, choose expectancy theory. However, I am not sure that I would take this position next week. Increasingly I find myself attracted to Bandura's (1969, 1971) social learning theory approach.

As a rule I have not been particularly enamoured of approaches to motivation derived from learning theories. This is partly because they require one to generalize from the behavior of rats to the behavior of men. But it is also because most learning theories seem far too simple to be applied to complex social situations and because of their near exclusive emphasis on reinforcement through tension or drive reduction. In Bandura's theory, however, I find none of these undesirable characteristics. His theory is based on and supported entirely through research with human subjects. The theory emphasizes man's capacity to learn large integrated units of behavior by observation, without having to build up the patterns by trial and error. There is also a place in the theory for man's cognitive capacity through which external influences can be represented symbolically. Finally there is recognition of self-regulating influences, i.e., men are seen as able to control their own behavior to some extent by managing the stimulus determinants of activities and producing consequences for their own actions. According to the social learning view, . . . "man is neither driven by inner forces nor buffeted helplessly by environmental influences. Rather, psychological functioning is best understood in terms of a continuous reciprocal interaction between behavior and its controlling conditions (Bandura, 1971, p. 3)."

Whereas in traditional learning theory the reinforcement works backwards to strengthen preceding responses, the social learning approach argues that informing the subject in advance, particularly in observational learning situations, about the payoff value for some behavior, rather than waiting for the behavior to be exhibited, will result in a faster learning sequence. Bandura's "anticipations" appear to be analogous to Vroom's "expectancies," his "incentives" appear to be analogous to Vroom's "valences." For expectancy theory and for social learning theory the incentive or valence serves a stimulating function to either create attention or direct action. Thus, social learning theory seems to incorporate major elements of expectancy theory. On the surface, at least, it would seem that a merger of these two theories might prove very fruitful.

Let us shift gears now and speak about motivation from a slightly different perspective. In working with organizations I have been impressed by the frequency with which problems in the area of motivation are mentioned. Quite often, however, when managers are asked to describe the problems in detail they have difficulty spelling out precisely what people in their organizations should be doing to demonstrate higher levels of motivation. Recent papers by Nord (1969), Jablonsky and DeVries (1972), and Porter (1973) have advocated the use of operant conditioning techniques to modify the behavior of workers. Although operant techniques have been used in classrooms, prisons, and hospital wards they have not been used to any great extent in business and industrial settings. As Nord has suggested, "Modern Americans, expecially of the managerial class (including some organizational psychologists), prefer to think of themselves and others as being self-actualized creatures operating near the top of Maslow's need-hierarchy, rather than as animals being controlled and even 'manipulated' by the environment (pp. 376-377)." Nord attempts to soften the blow by suggesting areas of overlap in the thinking of Maslow, McGregor, and Skinner, and by pointing out that each is interested in changing environmental conditions to produce changes in behavior.

Jablonsky and DeVries (1972) describe the presence of multiple reward and punishment contingencies in the work environment and individual differences in the effectiveness of reward contingencies. This leads them to a model of motivation which is essentially a combination of operant conditioning principles and expectancy theory. According to the model, ". . . an individual within an organization is surrounded by several unique social environments, each of which applies a possibly unique set of reinforcement contingencies for each of several behavioral alternatives. In addition, the model recognizes that the final forces for behavioral change result from interactions between multiple reinforcement contingencies and the values an individual places on the various reinforcements (p. 354).

Thinking in operant terms leads one to specify the behaviors to be modified and to identify the available reinforcers. In work organizations the behaviors to be modified are generally such things as absenteeism, tardiness, or the quantity or quality of output. Identifying the reinforcers requires a bit more imagination, particularly when it comes to setting up reward contingencies. As Porter (1973) has pointed out, modern organizations are relatively quick to alter the work environment when it comes to the introduction of new technology. Yet these same organizations have ". . . come to believe that compensation, work and non-work schedules, performance feedback, and other similar elements of the work environment are sacred cows that must not be disturbed lest changes create worse problems than they were designed to solve." Porter argues that organizations in the future must recognize that work environments are highly adaptable and will have to be restructured so that rewards relate to specific behaviors.

Generally, there seems to be a growing interest in the application of operant techniques. The United States Army, for example, has employed contingency management systems for basic training. Datel and Legters (1970) developed a token economy reinforcement system involving a variety of military training activities such as barracks inspection, standing formations, rifle range training, and so on. Officers and noncoms were taught to punch specified areas on the trainee's card when reinforcement criteria were met. When enough points were accumulated they could be exchanged for privileges such as weekend passes or movies. Emery Air Freight claims to have saved 2 million dollars in their containerized-shipment operation through the use of contingency management, feedback graphs and checklists.

If organizations can be pursuaded to loosen up a bit and begin to explore reinforcement contingencing and alternative reward systems, the future of motivational research looks very bright.

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A RESEARCH MODEL FOR MEASURING MOTIVATION: A SUGGESTED APPROACH

Sheldon Zedeck

The intent of this presentation is to briefly discuss the underlying notions of one model that *has been* used by behavioral acientists in the study of motivation and, then to describe, in somewhat greater detail, a suggested, but as yet untried, approach for studying motivation that overcomes the inadequacies of the traditional approach. The differences between the traditional and the suggested approach are basically ones of *perspective* and *focus*. To preview, it will be proposed that motivational research be examined from the perspective of *decision making* or *information processing* models and that processes pertaining to *within-individual* assessments be emphasized.

Definition of Motivation

Prior to a discussion of research models, it is necessary to define the term "motivation." An accepted definition is proposed by Vroom (1964) who defines motivation as". . . a process governing choices made by persons . . . among alternative forms of voluntary activity." A more elaborate definition is proposed by Campbell, Dunnette, Lawler, and Weick (1970). Their position is ". . . that an individual's motivation has to do with (1) the *direction* of his behavior, or what he *chooses* (italics mine) to do when presented with a number of possible alternatives; (2) the *amplitude*, or strength of the response (i.e., effort) once the choice is made; and (3) the *persistence* of the behavior, or how long he sticks with it. The term "motivation" conveniently subsumes a number of other variables such as drive, need, incentive, reward, expectancy, etc." (p. 340). The key notion, for this presentation, in these definitions is "choice among alternatives."

According to Campbell *et al*. (1970) there are two approaches to classifying motivational theories: (1) mechanical or process theories; i.e., explaining and describing the process of how behavior is energized, how it is directed, sustained, etc., and (2) substantive or content theories; i.e., identifying *what it is within an individual* (italics mine) that energizes and sustains behavior. The key notion in this classification scheme is the "process within an individual."

One example of a process theory is Vroom's (1964) instrumentality theory. Vroom argues that the motivational force or effort an individual exerts is a function of (1) his expectancy that certain outcomes will result from his behavior and (2) the valence (strength of preference), for him, of those outcomes. The valence is a function of its instrumentality for obtaining other outcomes and the valence of these other outcomes.

Vroom represents his basic model mathematically as $F_i = f_i \sum_{j=1}^{n} (E_{ij}V_j)$ where F_i is the force to perform act i, E_{ij} is the strength of the expectancy that act i (e.g., working hard) will be followed by outcome j (e.g., high salary) and V_j is the valence of outcome j. The key notion in this representation is that motivation is explained by a process involving "summation within an individual."

To integrate the above brief review of common explanations of motivation, note what is implicitly or explicitly postulated. The first concern is with individual's processes; not group behavior, not average behavior, but how an individual perceives his environment. Second, as indicated in Vroom's mathematical expression, we are concerned with summing effects within an individual. The cross product of $E_{ij}V_j$ and the summation of these results indicate that the force to act, motivation, is a function of many factors, possibly of differential relevance within the individual, and their interactions.

Third, the explanations emphasize that choice is involved. In essence, the individual is faced with a decision-making task. Given alternatives, how does he act? For example, given that an individual is presented with a certain salary, some security, a high prestige position, and an intrinsically interesting job, will he join one organization rather than another?

Fourth, the above explanations indicate that motivation can be studied by examining potential alternatives and their effect on behavior. In other words, independent variables such as rewards, incentives, needs, drives, etc., and their relationships to dependent variables or responses such as effort, performance, persistence, commitment, etc., should be examined. Motivation is a process. This process involves a consideration by the individual of the independent variables in conjunction with a decision (response). It is not an isolated process. When we ask someone, "What is important?" we indicate "important for what." The implication of this for the study of motivation is that a relatively simultaneous investigation of independent and dependent variables might be more fruitful than doing one study on independent variables and then a subsequent study focussing on dependent variables.

To summarize, the implications of the motivational definitions for motivation research is straightforward; it is the examination of the relationship between independent variables and dependent variables for an individual faced with a decision-making task. Any motivational theory is valuable for understanding and predicting behavior if it can identify the important variables and the processes by which they influence behavior.

How Motivation Has Been Studied: The Underlying Notions.

What has been the basic model for the study of motivation? Traditionally, researchers have been concerned with the importance of certain job characteristics, the needs of workers, preferences for rewards, job satisfaction, and the relationships between performance and rewards.

This presentation will emphasize the identification of goals, needs, etc., and their importance. The research in this area has generally used rating scale data. Respondents are requested to indicate the importance of various facets, intrinsic or extrinsic to the jobs. Each facet is considered without regard to its relationship with other facets. Results of this process are usually averaged and analyzed in terms of group data. That is, we will find the average importance of salary, the average importance of security, etc. Comparisons between groups, e.g., levels of management, between white collar and blue collar, successful vs nonsuccessful, etc., are then made.

Examine this design. Individual A provides the information about the importance of salary, possibly with respect to whether he remains with the organization. By examining his data relative to other members of his group, for that is the averaging process, statements can be made with respect to whether his preference for salary is higher, lower, or about the same as the model member of his group. This averaging process for other rewards, etc., is repeated. In the end, there will be normative comparisons, such as, salary is more important to Individual A than it is to other individuals in the group, whereas security is less important for Individual A than it is for other members of his group. Importance has thus been measured on an absolute scale.

To maximally utilize the data and analytical strategies, take the average importance of salary for one group, e.g., upper management, and compare it to that of lower management. In other words, differential importance has been examined based on clusters of groups formed and the a priori condition of level in the organizational hierarchy.

The same analyses are performed and conclusions drawn regardless of the procedures used to collect the data. Other procedures besides rating scales are projective tests, interviews, and self-report questionnaires. Basically, the data collected have been analyzed according to a normative model, or between group comparisons. These analyses have been done at the expense of within person data and within person comparisons; the comparisons really dictated by the definitions and representations of motivation. That is, the concern should be with the importance of one goal relative to the importance of other goals for the same individual.

Recently, Blood (1973) presented a strong argument for within person comparisons. Blood argued that an individual responds to his work environment according to his personal hierarchy. Knowing that A has a lower preference for salary than B is not extremely useful. Rather, it is important to know that salary is most important for A relative to other possible rewards. In other words, relative position of rewards, preferences, motives, etc., within an individual is the crucial aspect.

Why is within person information valuable? One basic answer is that it allows us to reward differentially. That is, if a person's most preferred reward is salary, then the organization may use money as a motivator for him. If a person's most preferred reward is extra vacation, then the organization may accordingly reward him. Reward schemes can be adopted to fit the individual. Normative analyses stress group or average data. Within person analyses stress the individual, the entity that motivational definitions focus on.

From the organizational viewpoint, it would be most beneficial for the organization to identify those subgroups who have similar personal reward preferences or hierarchies. Those who have the same rank order for preferences could be treated similarly by an organization. Analyses that would result in identifying groups of workers that have similar preferences are more valuable than knowing that upper managers, on the average, have a greater preference for salary than middle managers.

The actual research task used by Blood (1973) for studying within person preferences requires choosing among alternatives. Data are collected in a paired comparison format resulting in ipsative scores. That is, there is a fixed quantity of points among ten dimensions (rewards) specified. For each individual, the total score over all dimensions is equal.

The data obtained from the use of the ipsative procedure, however, is in some respects treated as normative data have been. Groups formed _a priori_ on the basis of, e.g., organizational level, are then compared, by use of a multivariate t test, for differences in importance of the set of 10 variables. The results may tell us that there is a different average ranking of the dimensions between the two groups. But, do such results imply that upper managers should be rewarded by one scheme and lower managers by another? The answer is not really known. It is possible that one subgroup of upper managers would require one scheme; a reward scheme that might be similar to one offered to a subgroup of lower managers. The multivariate analysis might be masking within person differences. Thus it might be better to statistically identify clusters or groups who have similar preferences rather than from groups on an _a priori_ basis.

At this point, several shortcomings in the traditional approach for the study of motivation should be noted. First, most research has been of the survey type where the focus has been on variables that could be referred to as independent variables. Assessment of dependent variables and how they relate to the independent variables has often been ignored. What would be desirable is a simultaneous assessment of the relationship between independent and dependent variables. Second, within person comparisons have been ignored. Where within person comparisons have been emphasized (Blood, 1973), analyses may not be complete. The relationship between within person comparison information and meaningful criteria have been ignored or the within person data have been analyzed according to normative models. What is needed is a research approach that identifies the important influences (motives) that are related to behavior (decisions) and that identifies individuals who have similar relationships.

Basic Research Model

The proposed research model for motivational research is drawn from those used for the study of information processing in judgment. The motivational problem is one of determining the factors causing behavior within an individual. To the extent that an individual can understand and assess information or alternatives available, he does so through application of an implicit or explicit policy and the relation of his goals to that information. The policy that motivation research should be concerned with is the individual's set of rules for utilizing available information, or consideration of alternatives, in order to reach a decision or energize behavior in a situation.

The concern in the remainder of this presentation is with human judgment and decision making pertaining to motivational research and, in particular, with the processing of information that precedes and determines these activities. The focus will be on a way of determining the processes and strategies that persons use in order to integrate diverse bits of information about outcomes into a force to perform an act.

Two basic approaches have been used to study information processing, regression (correlational analysis), and Bayesian analysis (Slovic & Lichtenstein, 1971). The regression approach will be adopted for this presentation.

The basic paradigm is a correlational one. Judges make quantitative evaluations of a number of stimuli, each of which is defined by one or more qualified cue dimensions or characteristics. In motivational terms, the concern is with the evaluation of outcomes, rewards, incentives, needs, etc., in a decision to expend effort, make a choice, or perform--three dependent variables in motivational research mentioned by Campbell et al. (1970). With respect to terminology, cues are the rewards, incentives, motives, etc., whereas judgment or the criterion is the choice, decision, effort, or performance.

Since regression analysis is being used, how the relationships operate can be seen by examining correlation coefficients. The correlation coefficient between cues and the judgment reveals the subtle, inferential activities of the inferring person. The coefficient represents the relative degree that the judgment depends on the various cues or alternatives or rewards available to the decision maker. It does so without asking the respondents to explicitly evaluate the rewards; all is inferred from examining the dependent variable, the decision. At no time does the individual have to overtly respond in regard to the rewards. At no time does he overtly make value judgments about the rewards. In brief, it is possible to capture an individual's decision-making policy, set of rules, by using regression analysis. The purpose of the regression analysis is to understand and describe a respondent's idiosyncratic method of combining and weighting information by developing equations representative of his combinatorial process. The next step is to cluster individuals with similar equations--information necessary for effective organizational policy with regard to rewarding its members.

The procedure is fairly traditional but with a few contraints. First, the situation is controlled. All judges or decision makers have the same stimulus dimensions available; i.e., have the same information about the task. This information is in a quantititative form. Second, for the poses of this presentation, a linear model is assumed; i.e., decisions are based on a linear combination of each of the available cues. The equation or decision rule can be represented as:

$$\hat{D}_I = \sum_{i=1}^{k} b_{iI} R_i$$

where D_I is the respondents decision, R_i are the rewards (needs, motives, incentives, etc.) available, and b_{iI} are the beta weights or measures of importance of each reward. (Beta weights are arbitrarily chosen as indictors of importance. Other possible indicators are mentioned below.)

In the typical regression analysis of information processing design, the input is in quantitative information. The response is a single valued assessment about some conceptually continuous variable. An additive model that is also static is adopted. That is, the decision rule is based on many trials or decision-making situations and the constraint is that the respondent's view of the world is stable over this period. The rule is based on a least squares criterion. This, in sum, is correlational- regression analysis.

A brief example presented by Dawes (1971) illustrates the use of regression analysis for the study of information processing. The problem was to determine policies of a committee charged with graduate admissions. There were four members of this committee. The input was (1) Graduate Record Exam (GRE); (2) undergraduate grade point average (GPA), and (3) a quantitative index of the quality of the undergraduate institute for 111 applicants. The dependent variable, decision pertaining to admission, was a seven point scale ranging from "reject now" to "offer a National Defense Education Act or other fellowship." Average ratings were used as dependent variables. Multiple regression analysis indicated that the multiple R was .78. The highest beta weight was associated with GPA, and the lowest with quality of academic institute. In essence, the regression equation captured the policy used for admissions. This equation can be used in subsequent admissions decision situations; the equation, in effect, replaces the committee.

This regression analysis model has been used to study personality characteristics (Hammond, Hursch, & Todd, 1964), attractiveness of stocks (Naylor & Wherry, 1965), potential for achieving minority group equality as a function of legislated and educational opportunities (Summers, 1968), beauty of paintings (Holmes & Zedeck, 1973), and other tasks. Some of the tasks are real, some are artificial.

Before a specific application of regression analysis for motivational research is presented, it is necessary to briefly mention one extension of regression analysis for information processing and one potential problem. The extension is an important one--it involves developing regression equations for each judge rather than one equation for the whole committee. If each judge independently makes judgments for each of 111 applications, then it is possible to develop a regression equation for each judge which would capture his policy. For the committee in the above example, four equations could be developed.

It is possible to group or cluster judges based on their regression equations. Procedures developed by Christal (1968), Dudycha (1970), Naylor and Wherry (1965), and others are based on clustering judges in terms of the homogeneity of their equations. The effect of these procedures is to allow us to determine whether 1 or 2 or 3 or 4 different policies for admissions exist among the committee members; i.e., individual differences in the committee with respect to weighting policies can be assessed.

The problem alluded to above pertains to the determination of the "important" cues. Darlington (1968) has proposed several measures for determining relative weights of variables in regression equations. One is the individual validity squared; i.e., the square of the relationship between the cue and the criterion. A second measure is the standardized beta weights. A third measure is to examine the amount R^2 decreases when a variable is eliminated. Hoffman (1960) proposed another measure which is $(b_{iI} \times r_{iD})/R^2$. The sum of the relative weights is 1.0 and, thus, Hoffman's measures describe the relative contribution of each of the cues as a proportion of the common variance. However, the appropriateness of all of the measures is limited when the cues are intercorrelated. This problem, however, can be overcome by constructing independent cues, in particular, by producing factorial combinations of cues.

A bit of evidence on weighting is relevant at this point, Research pertaining to self-insight in decision making has indicated that judges strongly overestimate the importance they place on minor cues, and they underestimate their reliance on a few major variables (Hoffman, 1960; Slovic, 1969). Subjects do not realize that their judgments can be predicted by only a few cues. Usually 3 cues account for over 80% of the variance in the judges' responses. The question thus becomes: Do all respondents use the same 3 cues and to the same degree?

Motivational Research and Policy Capturing

A project which began a year ago was to determine the factors influencing organizational choice. The emphasis is on organizational choice and not occupational choice. What are the factors that influence an applicant's decision to join IBM rather than Honeywell, given that he wants to be a computer programmer? Or, what are the factors that influence someone to join the Navy rather than the Army?

This project was studied in the relatively traditional way. Subjects were seniors at UCB who were taking interviews at the Placement Center. A list (based on a review of the literature) of 17 factors that have been considered related to jobs was formed--factors such as learning new things, advancement opportunities, variety in work, salary, personal growth, etc. These factors are outcomes, needs, rewards, incentives--the independent variables. Subjects responded, at the outset of the project, in terms of the importance of these factors. Average importance rankings (N = 90) indicated that feeling of worthwhile accomplishment, personal growth and development, and learning new things were most important. Working as part of a team, freedom from supervisor, and high prestige and social status were least important. Note that the normative model was used.

After each subject took an interview with an organization, he indicated, among other things, the opportunities to obtain each of the factors in that organization. At the end of the year, subjects indicated their most preferred organizations, their least preferred organizations, and the organization whose offer (if any) was accepted.

The results are not important for this presentation. What is important are the problems and inadequacies associated with this design and project. First, it already has been emphasized that information about individual goals, etc., is lost by averaging. Second, the longitudinal study created problems since the subjects were volunteers. At the end of the year, only about 25 subjects were available for data analysis. Many subjects did not provide information after each interview, many subjects interviewed off campus, etc. But most important, the cues or information provided to each individual were not constant within an organization or across organizations. That is, two subjects could be interviewed by the same organization for the same job. Often, they would not be given the same information, possibly because the interviewees asked different questions. Thus, they did not have the same basis on which to judge their opportunity to obtain some of the goals. Also, on occasion, information for the same variable differed; e.g., different salaries. Finally, not all companies provided information about each of the goals.

The result of this experience is to propose the use of the regression analysis paradigm for the study of organizational choice (choice of branch of the armed forces, choice as to whether to reenlist, types of duty desired, etc.). The information obtained would be beneficial to understanding both the organization and the individual. From the perspective of the individual, we learn the factors or goals important for him; from the perspective of the organization, it is learned what goals or factors are to be emphasized or rewarded at time of decision making.

The major step is to simulate the interview situation. To do this, a paragraph that describes Organization X is developed. In this paragraph, information might be provided about (1) starting salary, (2) opportunities for advancement, (3) special abilities required, (4) work environment,

(5) security, and (6) personal growth. These six independent variables are used with various parameters in different paragraphs describing different organizations--but all for the same job. The choice of these six variables is arbitrary. One paragraph might read as follows:

> "The starting salary in Organization X for Job A is $12,000. Within 6 months, you will be advanced to Job B. Advancement could be facilitated if you are able to perform *t* (some specialized task). To perform Job A, you will have your own work area. If you perform satisfactorily and remain with us for 3 years, then you will receive tenure. We encourage and financially support your participation in working and other educational opportunities."

A paragraph for Organization Y might read:

> "The starting salary in Organization Y for Job A (same job as in Organiz ation X) is $10,000. Within 3 months, you will be advanced to Job B. There is no way to advance sooner than that. To perform Job A, you will work in the same room as six other persons. If you perform satisfactorily and remain with us for 2 years, then you will receive tenure. We encourage your participation in workshops--we will permit time off but cannot provide expenses."

A third paragraph for Organization Z might read as follows:

> "The starting salary in Organization Z for Job A is $17,000. Within a year, you will be advanced to Job B, but only if there is an opening. You will work in the same room as three other persons. Performance is evaluated every 6 months, with unsatisfactory performance resulting in dismissal. There is no time off to attend workshops or to further your education."

Many more paragraphs can be written with some realistic combination of the six variables. Assigning numerical values for each variable is nothing more than a scaling problem. The variables could be developed to be relatively independent of each other.

Suppose 25 paragraphs, or descriptions of organizations, are presented to each of 100 subjects. (Number of subjects, paragraphs, and variables is arbitrary for this presentation.) The response of each subject to each paragraph is "desirability of joining the organization." A seven-point scale ranging from "definitely want to join" to "would not join if it was the last organization on earth" could be used. This response is the dependent variable. Thus, for each subject, 25 responses are obtained.

Regression analysis would indicate the relationship between the response, desirability of joining the organization, and the cue information, job characteristics.

The regression equation would provide information about the most important characteristics or factors contributing to the decision about desirability of joining an organization. Regression equations would be developed for each subject. Clustering programs (Christal, 1968) would be used to identify those subjects who have similar equations, those who value the same factors to the same degree. Suppose further that results of clustering indicated three policies or three sets of equations. Discriminant function analysis could then be used to identify those variables that distinguish the three policy groups. Demographic, personality, attitudinal, etc., variables could be the independent variables in the discriminant function. These variables might be considered as moderators of the job characteristic-decision relationship (Zedeck, 1971) or moderators of the policies. Moderators indicate subgroups for whom a relationship between two variables exists and subgroups for whom there is no relationship. In the proposed project, moderators identify subgroups for whom certain equations are appropriate.

The organization can use this information in one or more ways. First, not all information about an organization would have to be presented to each individual. This would save time and money. Based on the moderators, if someone is a member of Equation No. 1, then a certain set of information is presented to him. Someone of Equation No. 2 receives a different set of information (information about different variables). This might mean that not everyone has to be invited to see the plant or factory, etc. Not everyone would want to meet the supervisor or the members of his group. Not everyone would want an enlarged job.

Second, results could indicate that differential rewards would be offered to applicants. Applicant A for Job A would be offered a starting salary of $10,000 but promotion at the end of three months, etc. Applicant B for Job A would be offered $12,000 but promotion at the end of a year, etc. This differential rewarding is similar to Nealey's (1963) "cafeteria reward scheme." Third, the organization could focus its recruitment efforts on only these applicants who want the rewards the organization offers.

Conclusion

The regression analysis paradigm is an appropriate model for studying motivation. The individual is the focus; within person comparisons are maintained. Also, simultaneous examination of the relationship between needs, motives, rewards, and some behavioral aspect is achieved. Finally, the organization is able to use the obtained information in establishing policies for recruiting and rewards.

Traditionally, results of these studies have been used to "replace" the decision maker with his equation. For motivational research, results may be used to determine what information should be provided. The advantage to knowing someone's equation before he actually embarks on the interview road is one of reliability. A bootstrapping phenomenon (Dawes, 1971) has been observed. Simulated judgments may be better, in the sense of predicting some criterion or implementing the subject's personal values, than are actual judgments at any given time. This results because the decision maker, at any given moment, lacks the reliability of his equation.

Finally, the advantage of this procedure is better understanding. Focusing on the individual as the unit of research while simultaneously maintaining methodological rigor (controlled situation, maintaining large N, etc.) makes it possible to achieve a high level of psychological description and understanding.

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SECTION V

MEASUREMENT AND PREDICTION

Dr. Bernard Rimland, Chairman

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BIOLOGICAL APPROACHES TOWARD THE PREDICTION AND ENHANCEMENT OF HUMAN PERFORMANCE

Bernard Rimland, PhD

There is a good deal of overt dissatisfaction--and, in my opinion, it is well deserved--with the rather dismal progress achieved by the behavioral and social sciences during the past several decades. Personnel psychology is no exception. The comment has been made by a number of people, for example, that if one were to average all the validity coefficients computed during the 1970's, and compare them with the average of the validities obtained during the 1930's, no significant improvement would be found to have been achieved in that forty year period.

Selection research is by no means the most backward of the areas to which psychologists have addressed themselves. Much less has been achieved in other areas.

For some time, I have been aware of this problem and wondering what can be done. Where have we gone wrong? What is missing? It seems to me that a major possibility for getting personnel psychology back on the right track resides in building bridges to biological psychology. Major developments have taken place in biological psychology in the past decade or two that should be capitalized upon. You have often heard the term "overlap." I propose the word "underlap" to characterize our present dilemma. Effort is needed to fill in the large gap between what our biologically-oriented colleagues have learned and what personnel psychologists have placed into practice.

Some of the work at the Navy Personnel Research and Development Center is devoted to filling this gap. I will describe parts of this work, and tell you about some of our related ideas, not yet at the research stage, which we hope to be able to investigate in the future.

Brain Wave Research

For the past several years our laboratory has been doing collaborative brain-wave research, under Office of Naval Research sponsorship, with researchers at the University of California Medical School in San Francisco. The project involves getting numerous brain wave measurements (evoked responses) from the subjects as they watch a flashing light. They are instructed to signal via a hand-held switch to indicate whether the light is dim or bright. Electrical signals showing multiple aspects of functioning are collected from electrodes in contact with the subjects' scalps. Response latency and amplitude, differences between signals from various parts of the brain, and habituation rate are among the large number of measures tape-recorded from each subject. The tapes are then sent to the medical school laboratory in San Francisco where they are computer-scored. The scores are then returned to us for further analysis.

After the men tested have been in the Navy 18 months, we plan to follow them up to get indices of performance of special interest from the personal standpoint, such as grades in training, supervisory ratings, and records of disciplinary infractions.

For these men a wide range of scores on various paper and pencil tests, both operational and experimental are available. Analyses will thus permit evaluation of the brain wave tests against both performance criteria and aptitude tests.

In the past few years the popular press has carried numerous articles on the work of John Ertl, of the University of Ottawa, who pioneered the use of computer-averaged evoked responses as a means of testing intelligence. He has reported correlations in the .50's between his brain wave measures and scores on traditional IQ tests. However, others who have tried to replicate this work have not been able to do so. We hope that our study will cast some much needed light on this problem.

An extremely interesting aspect of brain wave research that we would like to explore involves the rather marked differences between the functions of the right and left hemispheres of the brain. Most of the paper and pencil tests used involve reasoning, verbal ability, and other high-cognitive analytical tasks, which are primarily the left hemisphere's job. Quite possibly the "Low Correlation Syndrome" results, in part, from the fact that an important function of the world's work may be performed by the right hemisphere, whose activities are much harder to measure with paper and pencil tests. The job of the sonar operator, for example, requires coping with several kinds of stimuli at the same time, and weighting each stimulus differently as determined by changing circumstances. This appears to be the kind of thing right-handed people may be especially good at. At least, an effective right hemisphere may be a necessary, if not sufficient, prerequisite for a good sonar operator. It is a reasonably straight-forward research task to find if superior sonar operators differ from average or below average men in terms of evoked response measures.

There are other interesting things that can be done with brain waves that have important implications for personnel psychology. For example, despite the popular press reports which suggest that the main function of biofeedback may be to give Nirvana seekers a drugless "high," some serious research has been conducted which suggests that feedback of brain signals can have some important military-personnel applications. Monitoring a sonar or radar scope can be a very monotonous task. Men begin thinking of their next date, or the last one. It is possible to feed brain wave input into a switching device so that a drop in attention level rings a warning bell intended to alert the man, or his supervisor. Similarly, students could be hooked to such a monitoring device so that brain wave activity of a non-business sort could be detected and extinguished. Conceivably, after a person had a good deal of experience with this kind of feedback, he might be able to control his attention, and therefore his learning, to a far better degree than before. Why do students having similar measured ability often differ markedly in their school achievement?

"Motivation" is the usual answer. But suppose the "unmotivated" student simply was not skilled in deploying his attention effectively? Would training him to do so via biofeedback make him a better learner? Maybe.

The Center has recently acquired terminals for the Plato IV instructional system, for which the computer is situated at the University of Illinois. We would like to monitor the brain signals of recruits being tested via the Plato terminal. We might learn some interesting things, to facilitate both selection and training practices, if we were able to get real time recordings from the right and left hemispheres of the recruiters as they first confronted, then attempted to solve, test items requiring verbal, spatial, or both types of abilities.

Biochemical Testing

A number of laboratories have reported finding high correlations--sometimes in the .60's--between the level of uric acid in the blood and achievement. Such findings have been reported for various groups, including college professors, students, and business executives. Why not develop and measure the uric acid level to supplement the test scores now used as admission standards for student selection?

Along similar lines, researchers working under Office of Naval Research sponsorship have reported finding fascinating relationships between an individual's performance on a vigilance task and the level of adrenaline in his blood. For this study a catheter was first inserted into each subject's arm so small blood samples could be drawn at periodic intervals without the subject's awareness. The subjects were then asked to detect occasional flickers in a dim light for a three hour period. Most of the subjects suffered a severe decline in their vigilance performance, missing many flickers as their attention flagged. The level of adrenaline in their blood stream varied directly with their accuracy--the highest points in accuracy were associated with the peaks in adrenaline level. Interestingly, for a few of the subjects no decrement in vigilance was observed--and correspondingly the blood adrenaline level in these "non-decrementers" also remained high throughout the study! These are findings which have clear implications for selection research.

Light and Behavior

Let me give you one more example of an area of biopsychology that could have important implications for personnel psychology, if personnel psychologists were aware of it. John Ott is an expert on time-lapse photography--perhaps the expert in time-lapse photography. You have seen his work--motion pictures of trees and plants going through a year's cycle in a minute or less. In the course of doing photographic work for some of the Walt Disney nature films he discovered that he could not grow properly colored plants in his greenhouse. He found that the problem was in the color of the light the plants were exposed to. This led him to investigate the effects of the power spectrum of light--not only its intensity but also its color--first upon plants, then animals. He learned some truly remarkable things, which he has reported in several books and in a number of scientific papers. His most recent book, Health and Light, is a fascinating and impressive account of his findings. Most of us, and I specifically include myself, are inclined to regard light very lightly, so to speak, to make sure we have enough of it, then direct our attention elsewhere. That is clearly a mistake, judging from Ott's work.

Before going on to the behavioral effects of light, let me cite a few examples of the extraordinary effects upon measurable biological phenomenon in animals of changing the spectral composition of a light source.

When groups of C_3H mice, which are highly susceptible to cancer, were kept under pink flourescent light, spontaneous tumors and other bodily defects developed and the animals died at an average age of 7.5 months. By widening the spectrum under which other groups of C_3H mice were kept, a progressive increase in life span to an average age of 16.1 was achieved.

Other studies show the sex ratio of animals bred under artificial light can be highly dependent upon the coloration of the light. In experiments on goldfish and chinchillas, for example, the percentage of females could be varied from 20 per cent to 80 per cent by changing from blue fluorescent to pink fluorescent light.

The light variable, then, can obviously have powerful effects on hormones and other biochemical systems, but what about effects on behavior, especially human behavior? Here we must depart from laboratory observations and even anectdotal information. The information in Ott's writings is sufficiently provocative to make human experimentation seem very much needed. I am soon going to propose research designed to find the effect of adopting Ott's lighting recommendations on the performance of Navy personnel.

Ott notes that most of us nowadays are starved for ultraviolet light energy. We tend to be ultraviolet deficient in the way that our bodies can be deficient in a certain vitamin, and for somewhat similar reasons. In the cave-man environment and for ages before, while our bodies were evolving, almost all of the light we received was natural sunlight, which contains a good deal of beneficial ultraviolet radiation. Now our daylight is too often filtered through glass, which screens out ultraviolet, and our artificial light contains very little energy at the ultraviolet frequencies. Is this important?

Let me read to you a few paragraphs from Health and Light. I think you'll find these few paragraphs, excerpted from pages 101 to 106, as interesting as I did.

While in process of trying to decide how much ultraviolet to give the animals, my wife and I had dinner one evening in a restaurant known as "Well of the Sea," in the basement of the Hotel Sherman in Chicago. As soon as we entered the restaurant I noticed that there were black light ultraviolet lights placed throughout the ceiling. They had been installed solely for ornamental purposes, to cause designs on the waiters' coats, as well as the menus, to fluoresce in the otherwise subdued light. The next morning I went back to the restaurant with a meter to measure the intensity of the ultraviolet at various distances from the ceiling such as table level and the eye level of the waiters as they walked directly under the various light fixtures.

I also wanted to ask the captain of the waiters a number of questions. In view of the general concern, especially at that time, regarding danger of over-exposure to ultraviolet, I wondered how long the lights had been installed and whether he had experienced an unusually high turn-over among the personnel working in the restaurant. I asked him if any of his men had complained of any eye problem, skin cancer, or other difficulties, such as sterility, which might be attributable to working for long periods of time under the black light ultraviolet. The captain told me that he had essentially the same group of men working for him as he had when they had opened the restaurant 18 years before. He said that the ultraviolet lights had been in use continually during that time, and that the health record of his men had been so consistently excellent that the manager of the hotel had checked into the situation, with medical supervision, to try to determine why this particular group of men was always on the job, even during flu epidemics, when other departments in the hotel would be short-handed because of employees' illness.

I then talked to the manager of the hotel, who told me that these men working in the "Well of the Sea" seemed to be a particularly happy group--courteous and efficient, and all seemed to get along well together. He said no explanation had been found to explain this, and that, at the conclusion of the study, it was thought to be simply a coincidence that this particular group of men should be so healthy and content. I asked if the men had been given a health check-up at the time they were hired. The manager explained that this was not customary and that the men just happened to be at the head of the list when the waiters union was called on to staff the restaurant.

> On another trip to Florida I gave a lecture to an advertising club, and after I had finished my talk, Mr. Richard L. Marsh, manager of radio station WILZ near St. Pertersburg, told me of a similar situation. He said that some of the staff at the radio station had taken it upon themselves to try to brighten up their surroundings in both the studios and the control rooms by replacing the regular white fluorescent tubes with those of a deep pink color. About two months later, they began to have personnel problems. For example, announcers began performing poorly on the air. Everyone became irritable and consistently at odds with management decisions and generally difficult to control. Two resignations were received from employees without any known reason for their wishing to leave other than general dissatisfaction with themselves and the staff.
>
> Then, one morning one of the men said, "If those pink bulbs aren't removed I'll go out of my mind." That sparked an immediate reaction, and that very day all of the pink tubes were removed and replaced with the white tubes. Within a week, as if by a miracle, tempers ceased to flare, congeniality and a spirit of working together began to redevelop and resignations were withdrawn. The airwork improved, with mistakes at a minimum.

Ott also gives many illustrations of the effect on behavior of changing the color of the illuminating lights on fish and animals in zoos, aquariums, and breeding ranches.

Men on submarines would make an extremely good group on which to try the effects of full spectrum lightings. All we would have to do is change the fluorescent tubes on the experimental subs and leave the others alone. Would the dangerously low reenlistment rate on the subs go up? Would there be less interpersonal frictions? Fewer intra-personal problems? It would be fun to find out.

Enough. I hope I've convinced you that even though the biology and psychology departments may have occupied different buildings on your campus, they may in real life be less far apart than we thought.

VISTAS OF ANALYSIS:

QUALITATIVE PREDICTION AND DECISION ANALYSIS

W. J. Moonan, Ph.D.

Historical Analysis Trends at NPRA: Models and Methods

Being a statistician, I would not be so presumptive as to predict future aspects of "psychology in the seventies". Rather, I would like to put in perspective, some historical research analysis procedures carried on by workers in applied psychological research at NPRA from 1952 to the present. This period can be divided quite accurately into three analysis eras. The first, from 1952 to 1962, I refer to as the Correlation and Measurement Era wherein the primary model for analysis was the normal bivariate model which provided the theoretical basis for various types of correlation coefficients which were used in a myriad of research problems experienced by the Bureau of Naval Personnel. In the early part of this era, the desk calculator provided the only means for computation, whereas in the later stages primitive digital computers became available. Perhaps it would not be amiss to state that the major computer program was that which facilitated the computation of mutual product-moment correlation coefficients based on incomplete information for some of less than 40 variables. This program's crowning achievement consisted of producing correlation matrices relating the BTB and final school grade for each of eight-none Class A Schools whose sample sizes were usually less than four hundred.

The second era, from 1963 to 1973, I refer to as the Regression and Systems Analysis Era. During this time the correlation coefficient seemed to dwindle in importance and regression analysis models constituted the primary basis for analysis. It was during this time also that systems analysis and operations research processes were used for the first time at NPRA to help solve naval personnel problems. By this time fairly large and efficient computer systems were available and computer programs enabling the computation of regression analyses and variable selection procedures were programmed. In this description I have omitted many details and divergences from the major themes (correlation and regression) I have alluded to. Distinctive among these exceptions is the experimental work carried on by NPRA and NPTRL. I would expect that other chroniclers of NPRA would differ in detail from the aforementioned exposition. However it would be surprising to have them exhibit a categorization differing in spirit from that given above.

Future Analysis Trends at the NPRDC: Models and Methods

Judging from observed trends, present technology and apparent requirements, I would designate the decade from 1973-1983 as the Decision Analysis Era. The basis for analysis would be statistical decision theory utilizing many different mathematical models (listed below) for assisting top management in the Bureau of Naval Personnel in solving complex personal problems. In this process I believe a new language, founded on decision and systems analysis, called the language of decision analysis, will be created for effectively communicating between research personnel and the Navy management structure. The types of mathematical models to be utilized are:

1. Prediction Theory
2. Probability Theory
3. Mathematical Programming
4. Sequencing
5. Replacement
6. Allocation
7. Inventory
8. Dynamic Programming
9. Queuing
10. Competition
11. Routing
12. Simulation and
13. Game theory.

The digital computer will continue to be the basic arithmetic tool as well as providing display information for real-time management decision making. Our task is to learn the language of decision theory and to learn how to apply it in practical personnel problems. The key elements of the language seem to be the following:

1. Decision making -- To understand that the intuitive basis for actions can be supplemented but not replaced by mathematical logic.
2. Uncertainty -- To understand that uncertainty or knowledge may be encoded in the language of probability.
3. Complexity -- To understand how to describe direct and subtle relationships.
4. Dynamics -- To understand how the present affects the future.
5. Economics -- To understand the meaning of resources and their allocation.
6. Optimization -- To understand how to climb a hill you cannot see.
7. Modeling -- To understand how to structure in manipulable form.
8. Behavioral Science -- To understand that a major impediment to rationality is not the lack of logical tools but the fear that logic may expose inconsistencies and weaknesses.

Some New Models and Methods of Prediction.

Prediction analysis is the mathematical-statistical process of making inferences from what we already know (predictor variables or characters) to something which we would like to know (criterion variable or category). The domain of prediction analysis can be characterized by refering to the following table:

TABLE 1

Types of Prediction Analysis

		DEPENDENT VARIABLE	
		METRICAL CRITERIA	CATEGORICAL CRITERIA
INDEPENDENT VARIABLES	METRICAL PREDICTORS	REGRESSION ANALYSIS Type A	DISCRIMINANT ANALYSIS Type C
	CATEGORICAL PREDICTORS	ANALYSIS OF VARIANCE Type B	ABCD ANALYSIS Type D

[After Rozeboom (1966, p. 543)]

Types A, B and C prediction analysis have well known theoretical and computational bases which were thoroughly studied and utilized during NPRA's Regression Era. Type D predictions had not been extensively required heretofore but now (circa 1972) research required a solution for an important personnel problem. A hurried but thorough search of the literature showed no adequate mathematical, statistical or computer solutions and furthermore indicated (Lubin, 1950) that non-trivial approaches were infeasible and/or non-existent. Consequently, the only alternative was to develop a new approach. This was accomplished (Moonan 1972) thereby filling in an important quadrant of Table 1.

Subsequently, because the new methodology permitted the use of several hundred qualitative predictor variables, a selection technique program, CHAROSEL (Bowser, 1973) was developed. The CHAROSEL technique sequentially selects qualitative predictor characters leading to better predictions.

Qualitative Prediction Details

The fundamental problem of analysis arose because the prediction problem involved both qualitative criteria and predictors. The qualitative criteria were usually "classifications" such as"

1. Types of achievement
2. Types of career patterns
3. Types of training history
4. Types of training classification
5. Types of recidivism
6. Types of drug users.

The ABCD technique is not restricted, as in the discriminant function, to two criterion category prediction problems. The predictor variables are also qualitative and usually consist of responses of members of samples from the populations of interest to background or other questionnaires and/or responses to multiple choice tests. I have given the generic term "prediction analysis" to cover both types of analyses commonly referred to as "regression and discrimination" since both effect "predictions"; regression effects predictions of metrical criterion variable whereas discriminant analysis effects predictions of a categorical criterion.

The remainder of the first part of this presentation will be concerned with the theory, computer program and applications of the ABCD Technique and CHAROSEL. The second part of the presentation will discuss a particular formulation of decision theory and the application of this structure to an important naval personnel problem.

Decision Theory

Statistical decision theory was originated about twenty-five years ago by Abraham Wald. This theory had its precursors in the work of von Neumann (1928) and in the work of Morgenstern and von Neumann (1947) and has undergone new developments in the work of Savage (1951), Lindley (1965), Bellman (1957) and others. What is decision theory? This theory deals with the problem of decision making in the face of uncertainty. But since this definition is not illuminating, let us say that the methods of decision theory are universal, covering at least inductive reasoning, the design and interpretation of scientific experiments and subsume the sciences of statistics and operations research. Indeed, to some looked at most generously, decision theory represents scientific method and has applications independently and jointly in the fields of management and behavioral sciences.

THE DISCRIMINATION AND PREDICTION PROBLEMS

These problems are contrasted by the nature of the criterion variable. The discrimination method is a procedure for deciding into which of the K categories a new, randomly selected individual, known to belong to one of the categories belongs. In the classical discriminant function analysis proposed by Fisher (1936 and 1938), K was limited to two and the predictor measurements were quantitative. The classical prediction problem is that proposed by Fisher and others and exemplified in its most general case by the multiple regression model, Johnson (1949). The linear discriminant function (LDF) enjoyed wide application in the behavioral and biometric science fields, but suffered from the fact that it could be applied only to two category problems. This restriction was eliminated by C. R. Rao (1952) and other Indian statisticians who generalized the LDF concept by introducing new distribution, procedural and decision theory concepts into the classification problem. These techniques have come to be known as "Dispersion Analysis".

A limitation inherent in all of these solutions was that they applied only to predictor characteristics that were measurable and consequently could not be used for problems wherein the available basic predictor data was qualitative in nature. Esoteric techniques attempting to quantify qualitative data have not proven useful. If they were, standard dispersion analysis procedures would be more generally utilized. In personnel work criteria are frequently categorical in nature and predictor data are most generally available from questionnaires administered to samples of the populations of interest. Table 2 illustrates the kind of qualitative predictor data referred to.

TABLE 2

An Illustration of Qualitative Personnel Data

Active Duty Obligation

1 = 6 months
2 = 2 years
3 = 3 years
4 = 4 years
5 = 5 years

Age

7 = 17 years
8 = 18
9 = 19
0 = 20
1 = 21
2 = 22
3 = 23
4 = 24
5 = 25
6 = 26 or more

Race

1 = White
2 = Negro
3 = Other

Religion

1 = Protestant
2 = Catholic
3 = Jewish
4 = Other
5 = None

Education

1 = 6 years or less
2 = 7
3 = 8
4 = 9
5 = 10
6 = 11
7 = High School Graduate
8 = 1 year college
9 = 2 years college
10 = 3 or more years college

Service Rejections

1 = never rejected
2 = USAF
3 = USA
4 = USCG
5 = USMC
6 = USN
7 = Combination 2 or 3
8 = All

Because of the operational requirements, the ABCD Technique theory and program necessitated the incorporation of provision for numerous criterion categories and very large numbers of qualitative predictors generated through the use of questionnaires.

Approach to LDF Problems

Sir Ronald Fisher (1936) in his maximum likelihood deviation of the LDF assumed that predictor variables are measured, available and multivariate normally distributed. The LDF was a two-category problem solution and Fisher's idea was to form a single measurement, y, defined as a linear function of the C measurable predictor variables. Thus

$$y = l_1 t_1 + l_2 t_2 + \ldots + l_c t_c$$

The analysis problem is to determine the constants $l_1, l_2, \ldots, l_c$ such that the ratio of the between category variance to the pooled within category variance is maximized. Fisher's contribution was to show how the l-vector could be calculated. Classification or "prediction" is effected by funding a value y_o, such that if y were less than y_o the individual belongs to one category, or if y is greater than y_o, the individual belongs to the other category. Fisher did not explicitly utilize the decision table concept as a means of evaluating the LDF.

Approach to Type D Predictions

For any given Type D prediction problem the criterion categories and the predictor characters are specified, together with certain parameters required by the program. The population of interest is sampled in order to collectivise a subsample called, for our purposes, a "training sample". The purpose of this sample is to "train" the program by estimating the probabilities of endorsement of each level (alternative) of each predictor character for every criterion category. The prediction is effected by using a "cost of misclassification" matrix and posterior probabilities of categorical membership estimated from the endorsement and Bayes' theorem. The actual "prediction" is therefore a decision as to which criterion category a sample member is associated and the decision is determined by indicating that category associated with the minimum expected cost of misclassification.

These decisions are usually computed and assembled into a decision table whose rows represent known categories of membership and whose columns represent predicted categories of membership for members of a testing subsample. The training and testing subsamples are usually independent and large enough to accurately estimate endorsement probabilities and probabilities of correct and misclassification. Ideally, the decision table will contain frequencies only in its principal diagonal. Other frequencies are indicative of poor prediction or misclassification. The output of the ABCD technique program lists, for each testing sample member, the probabilities of categorical membership as well as providing the overall decision table.

QUALITATIVE PREDICTION: THEORY

In order to indicate the theory behind the qualitative prediction process known as the "ABCD Technique" it is necessary to develop a certain amount of notation. Let x_a^c represent the choice of the a^{th} alternative to the c^{th} qualitative character made by a representative sample member of a testing sample obtained from sampling the population associated the θk^{th} criterion category. Also, let us represent the vector of all x_a^c for a sample member by the symbol x. We can also represent the endorsement ratio probabilities estimated from the training sample by the symbol $p(x_a^c|\theta_k)$. We assume that there exist K criterion categories and that the probability of a sample member from the k^{th} criterion category responding to the c^{th} qualitative character is $p(x_a^c|\theta_k)$. Assume futhermore that the qualitative characters possess statistical independence (we shall comment further on this assumption later). With this assumption the total probability of the response vector x can be written as

$$p(X|\theta k) = \prod_{c=1}^{k} p(X_a^c|\Theta_k) \quad .$$

Our interest, however, is not attached to $p(X|\Theta_k)$, but rather to the inverse probability $p\ (\Theta_k|X)$ which can be obtained by using Bayes' theorem (1963) further assuming that we know the a priori probability of observing a member of the k^{th} category, $p(\Theta_k)$. Thus

$$p(\Theta_k|x) = \frac{p(\Theta_k)p(X|\Theta_k)}{\sum\limits_{\kappa=1}^{k} \rho(\Theta_k)\rho(X|\Theta_k)} \quad .$$

These K numbers are called posterior probabilities of category membership. We assume also that our previous analysis has included the specification of a K x K matrix called the costs of misclassification matrix, L(i,j), whose non-main diagonal elements indicate the loss associated with misclassifying a member, known to belong to the i^{th} category, into the j^{th} category. Using L and the posterior probabilities we compute the Bayesian decision values

$$B(j) = \sum_{i=1}^{k} p(X|\Theta j) \quad . L(i_1 j) \quad .$$

We make the decision $D(X) = g$ if $B(g) \leq B(j)$, $g \neq j$, $g,j = 1(1)K$, meaning that we make the decision that the member is a sample from the g^{th} category if B(g) is the minimum of all B(j). The letters ABCD represent the acronym "Attribute Bayesian Classification Decision" and because we use the Bayes' decision criteria we designate the technique as "Bayesi[illegible]". Actually, it is doubly Bayesian since we also use Bayes' theorem to calculate the posterior probabilities.

The Character Independence Assumption

The author was reluctant to utilize the character independence assumption mentioned above because of his experiences in dealing with qualitative variables. Frequently, they are weakly associated and the association is usually poorly estimated. However, there seemed to be no tractable means of computation if the assumption was not made and the decision to make it was reinforced by noting in the statistical literature and comments from other mathematical statisticians that "everybody dealing with multiple qualitative characters in Bayesian decision theory makes that assumption."

Actually, this is no justification but the decision to proceed with it turned out to be wise since subsequent applications of the technique, whether the data justified it or not, were relatively spectacular. Truthfully, I felt uncomfortable about it but have found no way to avoid it and still provide an effective means for making qualitative predictions.

IMPLEMENTATION

The ABCD Computer Program

The ABCD technique was programmed as a computer program for the NPTRL IBM 1130 system in 1972. The documentation for this program is specified in reference Moonan (1972). The program was skillfully coded in FORTRAN II by Mrs. Margaret Covher using analysis provided by Moonan. The program utilizes an input form and requires input consisting of:

(a) The number of categories and $p(\Theta_k)$.
(b) A cost of misclassification matrix.
(c) Endorsement ratio probabilities.
(d) Input forms.
(e) Data for the testing sample.

The output is a decision classification for each member of the testing sample and an overall decision table indicating the probabilities of all types of correct and incorrect classification of members of the testing sample. An overall measure of the total costs of misclassification are provided, and, at option cards containing the composite probabilities $p(X|\Theta_k)$ for each member of the testing sample.

Applications

The ABCD technique computer program has been applied to various types of problems among which are the identification or classification of:

(a) Undersea targets.
(b) Drug abusers.
(c) Naval personnel recommended or not recommended for reenlistment.

In the reenlistment example, the program made only three classification errors for a testing sample of three hundred twenty-four men utilizing information from a recruit temperament survey.

The program was also applied to the classical problem of discrimination first presented by Fisher (1936). This problem is known as the "Iris Data" problem for which three quantitative variables are available for classifying iris plants into one of three types of iris:

(1) Virginica
(2) Setosa
(3) Versicolor

For this problem the quantitative variables were arbitrarily qualified. The results of this application are shown below in Table 3.

TABLE 3

Frequencies of Classification of the Iris Data

		Assigned Classification			
		Vir	Set	Ver	Total
True Classification	Vir	33	0	0	33
	Set	1	29	3	33
	Ver	0	1	32	33
Total		34	30	35	99

For this application, the percent accuracy is about 94%. Over a wide variety of applications the percent classification accuracy has remained surprisingly high even when both training and testing samples were completely independent. The program has been shown to be operational, easy to use and relatively efficient. It has been surprisingly popular, being applied for analysis in several different types of research projects.

Prediction Types C and C & D

The linear discriminant function of Fisher suffers from limitations in its classical form. First it does not minimize costs of misclassification and usual forms of its computer program do not produce a decision table or decisions of categorical membership for each object in the testing sample. Consequently, a new type C discriminant technique was developed by Moonan (1972). This technique is called PGM: Probability of Group Membership, and was devised to overcome the aforementioned objections to the LDF. The PGM program works similarly to the ABCD program. However, it uses quantitative rather than qualitative predictors. The mathematical approach makes use of a subroutine called DENS, Moonan and Covher (1972), which computes, for each object in the testing sample, a multivariate normal probability density function for each category of the criterion variable. These density functions, when multiplied by the mathematical differential dx, represent probabilities and therefore can be utilized to calculate posterior probabilities in the same manner as ABCD. The differential elements divide out in this process, therefore their use is purely formal. As indicated in Moonan (1973), the analysis of covariance represents a solution to a prediction problem of type A&B. Correspondingly, a new procedure, programmed as MIX, Moonan (1973), contributes to the solution of type C&D prediction problems, i.e., problems where it is desired to predict categorical membership from knowledge of both quantitative and qualitative predictor variables.

Both the PGM and MIX computer programs and their applications are described in Moonan (1973).

SELECTION PROBLEMS FOR QUALITATIVE PREDICTIONS

Soon after the ABCD technique program was operational, it became obvious that some procedure was required to select a subset of the qualitative predictor characters. This was necessary because the program accommodated several hundred predictors and such sets were realized for some applications. Obviously, it was desired to reduce the predictor set to a s[illegible] number of effective predictors if the quality of prediction was not detrimentally affected. Table 4 shows various other types of prediction techniques, each has its own individual variable selection technique. Accordingly it was decided to devise a selection technique for Type D predictions and to call the technique by the acronym CHAROSEL, meaning selection of characters. The analysis for the program was devised by Moonan with contributions and expert computer programming made by Samuel E. Bowser.

The CHAROSEL Computer Program

The character selection feature invoked by CHAROSEL is obtained by computing decision tables and associative objective functions for each predictor character available. That character with minimum objective function is the first character selected. In the second stage, CHAROSEL combines the first selected character together with each other available predictor and selects the pair which produces the decision table minimum objective function. The predictor chosen in combination with the first selected character is then designated as the second selected character. This process is repeated sequentially until all available predictor characters are exhausted or until the program terminates because of data processing constraints.

An obvious objective function for the decision tables is an index measuring the degree to which the decision tables contain frequencies only in their principal diagonal. Such an index, utilizing information theory and ingenuity was devised by Bowser, and the optimal value of the objective function is unity.

The input to the program is similar to that required by the ABCD Technique program. However, upon request, CHAROSEL will compute the endorsement ratio tables from a training sample. The outputs are:

(1) A decision table for each character selected.
(2) Objective function values, objective function changes, percent correct decisions and change in percent of correct decisions.
(3) Characters are listed in rank order as they are selected.

Endorsement ratios are punched and listed if they are calculated by the program. The program is written in IBM 360/65 FORTRAN G and utilizes 375K slow core of an IBM 360/65. There are a few minor restrictions provided by Bowser (1973).

TABLE 4

Selection Technique Summary

Type	Prediction Class	Selection Technique	Working Reference
A	Regression	Accretion & Deletion	Johnson (1949, p. 331)
B	Anova	Test of Hypothesis	Snedecor (1962, p. 291)
B	Binary Assembly & Regression	Sequin	Moonan & Pooch (1966)
A,B	Binary Assembly	Sequin II	Moonan, Balaban & Geyser (1967)
C	Linear discriminant function	Mahalanobis D^2	Rao (1952, p. 252)
D	ABCD	CHAROSEL	Moonan & Bowser (1973) Bowser (1973)

Applications of CHAROSEL

The CHAROSEL technique has not been previously available but has wide applicability for research and other problems concerned with predicting categorical membership from knowledge of other categorical information. Some recently proposed applications include:

(1) The identification of potential hijackers of commercial aircraft.
(2) The identification of autistic children.
(3) The identification of stroke victims who can or cannot be relieved of paralysis by means of a cerebral operation.

The program is applicable to many problems of medical prognoses and dianoses. At NPTRL, CHAROSEL has been utilized for several naval personnel project analyses. Table 5 provides a summary of these applications. If allowed, CHAROSEL will select all available characters sequentially. In this process, an unusual phenomenon occurs, in that as the number of characters increases, the objective function value usually decreases to a point and then increases slightly showing that the addition of information does not always increase qualitative prediction. A similar phenomena was noted in an item selection procedure called Sequin, Moonan and Pooch (1966) and in regression analyses. The CHAROSEL output also assists as a "theory generator" in that the most discriminating characters are selected early and may be collectively members of the same class of variables.

Options to Assist Applications Analysis

The research worker who uses CHAROSEL has considerable freedom with regard to the type of procedure he wishes to utilize with this program. Experience has shown that such freedom is both desirable and necessary for programs intended to be utilized with a wide variety of applications and data sets. The options available are described as follows:

1. The endorsement ratios, $p(X_a^c|\theta_k)$, may either be supplied to the program by the user or the program will calculate them from sample data. This implies that the user need not dichotomize his data into both "training" and "testing" samples, but rather, may treat his data as one conglomerate sample, partitioned only with respect to criterion categories.

2. A limit may be given for the maximum number of variables which are "missing" on a sample member. For example, if the user specifies 5 for this parameter, the program will ignore any sample member with 5 or more missing variables in his record set. Missing data are allowed for by the program by utilizing one of the a -alternative levels as the missing data level.

3. Certain designated predictor variables may be forced to be utilized initially in the variable selection process.

4. If desired, the user may instigate a cross-validation analysis by using variables selected by CHAROSEL and then using the ABCD Technique program with another sample.

TABLE 5

CHAROSEL Applications

Problem Name	Criterion Categories	Types of Predictors	Training Sample	No. of Predictors Used	Objective Function Value	% Classification Accuracy
Drug Abuse Prediction	(3) A. Hard Drug User B. Recreational Drug User C. Abstainers	(139) A. Biographical B. Opinion Data	(362) Naval Recruits	(5) (18)	1.90207	61.6 68.2
Odds for Effectiveness	(2) A. Recommended for Reenlistment B. Not Recommended	(140) A. Biographical B. Self-evaluation C. Opinion	(320) Naval Recruits	(7) (19) (95)	1.38476 1.11748 1.00000	95.6 98.4 100.0
Skid Row Employment	(2) A. Completed Project B. Dropped Out	(52) A. Biographical B. Self-evaluation	(179) Skid Row Welfare Recipients	(13 (39)	1.39013 1.26212	85.5 88.8
Target Classification	(3) A. U.S. Subs B. Foreign Subs C. Surface Ships	(19) Sonar Clues	(91) Sonar Contacts	(1) (4) (19)	1.51500 1.07334 1.07334	70.3 95.6 95.6

5. The program utilizes an input form and a training or conglomerate sample; data may be entered either on cards or magnetic tape.

CHAROSEL Restrictions

The program is not completely amorphous but does impose the restrictions noted as follows:

1. The training or conglomerate sample size is required to be less than or equal to 500 members.

2. The number of criterion categories must be less than or equal to 10.

3. The number of a-alternative levels for each predictor character must be less than or equal to 10 (including the missing data level).

4. The number of predictor characters is limited by IBM 360/65 core size. The present operational program is restricted to a maximum of 200 predictor characters.

5. The present version of the program is operational only on an IBM 360/65 computer system and uses a core size of 375 K bytes.

6. Although the program has been utilized successfully for several applications, in the opinion of the author and the programmer, it is not sufficiently shaken down to the point whereby it could be utilized, without concern, for any data set. Consequently, the program is considered semi-proprietary. Prospective DOD users may arrange for program execution through

(a) Commanding Officer, NPRDC,
(b) The Personnel Utilization Directorate, and
(c) Director, Computer Applications Department. Other potential users should contact the author.

SUMMARY OF QUALITATIVE PREDICTION PRESENTATION

Three eras of analysis were identified during the history of NPRA, NPTRL and NPRDC. These eras were the correlation, regression and decision analysis eras. The latter, has only recent birth and is expected to continue for the next decade. During this initiation, it was recognized that statistical theory, local analysis and computer programs were unavailable for solving a certain class of prediction problem (Type D). An efficient solution to this type of problem is essential since this problem class is expected to occur, and indeed already has occurred, in naval personnel research activities. The solution to this problem was developed by the author in 1972 and subsequently realized that a character selection procedure was required to effectively utilize ABCD. Consequently, another computer program, "CHAROSEL," was devised by Moonan and Bowser, for character selection problems. Both programs are described in detail in this report.

PART B. DECISION PROCEDURES

Geniuses of Decision

Many men have made significant contributions to scientific decision making in the twentieth century. Among these are a few standing head and shoulders above the rest with respect to their contribution. One of these, John von Neumann, a Princeton mathematician, made an early contribution (1928) formulating the basis for the "theory of games" which formed a basis for future developments in decision theory. von Neumann also made contributions toward the development of modern digital computers and, in fact, was honored by having the first Rand Corporation computer which he designed, named in his honor (Johnniac). The next stage of the development was taken by Abraham Wald, a Rumanian immigrant and ultimately Professor of Mathematical Statistics at Columbia University. Wald developed the subject of statistical decision theory (1950) which formed the mathematical basis for most subsequent developments in decision analysis. Wald's contribution was to place, on a rigorous basis, a useful theory of processes for making decisions in the face of uncertainty about the future, thereby relieving mankind of the obligation (real or imagined) of consulting soothsayers, sibyls, cards, etc., for advice for good decision making. Interestingly enough, because decision making is still complex, there still exists a need for auxilliary help in spite of the newly-created decision tools. For example, the Air Force has the Rand Corporation, and other more private agencies such as Mathematica, RAC, Systems Development Corporation, and others stand by to assist their clients in the decision making process. von Neumann collaborated with the economist Morganstern (1947) in writing one of the most significant books of the modern technological era. This book, together with Wald's (1950) Statistical Decision Functions, will undoubtedly rank among the major scientific contributions of the first half of the twentieth century. It would be remiss not to include the name of Richard Bellman among our list of decision geniuses. Almost single handedly he developed the theory of dynamic programming which is a theory of making multi-stage decisions. Futhermore he has contributed, by 1961, 15 significant books and over 400 mathematical research papers--a truly prodigous effort. Dynamic programming in itself is a major contribution since it provides solutions to decision problems otherwise impossible or extremely difficult to solve.

Decision Making, Decision Theory and Decision Analysis

For hundreds of thousands of years, mankind has been making decisions without scientific assistance. We all realize, as history illustrates, that the quality of these decisions differ considerably. In recent years it has been realized that decision making may be described by a six-step procedure of the following form:

1. A point in time, called the Decision Point exists when the decision maker experiences a need for making a decision.

2. Then, the process of Exploration occurs when the decision maker considers and contemplates about all possible alternative actions open to him at the decision point, and acquires necessary facts and information.

3 During the process of Evaluation, he makes clear to himself the implications, values, utility, advantages and disadvantages involved in the alternative actions.

4. A tentative selection of an alternative is made during the Choice phase.

5. During Clarification the decision maker examines and reflects upon the tentative selected action to ascertain the wisdom of making it.

6. The final step occurs when Action is taken. We note that a decision is not a mental commitment to follow a course of action but rather the actual pursuit of that course of action.

It is encouraging and interesting to note that decision making and decision concepts have been and are being developed and applied to vocational decision making problems of high school and college students. In fact one of our conference speakers, Professor David Tiedeman, has been an early and long standing contributor to this effort. Some of this research has resulted in guides, computer programs, or manuals to be followed by high school students in planning their educational careers. The following references are indicative of their attempts. [Katz, N. B., (1971); Miller and Gelatt, (1971).]

These aspects, Exploration, Evaluation, Choice, Clarification and Action are symbolized and formally interrelated with mathematics in statistical decision theory.

The structure of decision theory has as many interpretations as there are interpreters. The following specification seems, to the author, a sufficiently simple and reasonable one. Our intention is to first characterize this structure and then to apply it to a naval personnel problem. The structure may be characterized as follows:

1. Specification of the Feature of Uncertainty. This includes the identification of the possible States of Nature (Θ). With respect to any decision problem the set of "States of Nature" is assumed to form a mutually exclusive and exhaustive listing of those aspects of nature which are relevant to the particular choice problem and about which the decision maker is uncertain. Although this characterization is quite vague, there is often a natural enumeration of the possible pertinent states of the world in particular context. We assume there is a "true" state of the world which is unknown to the decision maker at the time of choice or which is operating to produce results of observed events.

2. Determine information, X which is available about Θ. X is called the Record Set which may be obtained by observation, questionnaire or experiment.

3. Relate information, X, to that which is uncertain, Θ. This is usually done in terms of probabilities or probability density functions, $p(X|\Theta)$.

4. Specify the possible courses of action (a).

5. Determine the payoff or loss table, $U = u(\Theta, a)$, associating a payoff or loss with each possible action with each possible Θ.

6. Relate the information available, X, to the posssible actions, thereby specifying each X to an action: $P \times U = S = s(X,a)$. This process specifies possible strategies or policies (π) and is called "selecting a possible decision procedure."

7. Evaluate the "worths" of each policy including their admissibility and thereby look for uniformly best policies.

8. Select a decision criterion for choosing a single admissible policy.

9. Apply that criterion to select a policy for action.

10. Carry out the policy selected, thereby making the decision required.

Decision analysis is a logical procedure for balancing the factors that influence a decision. The procedure incorporates uncertainties, values and preferences in a structure that models a decision. Thus, the aspects of decision analysis are more formal than decision making but constitute a structure of decision theory somewhat different from that presented above. This decision analysis procedure is advocated by Howard (1966) and he provides the following outline of the process.

I. Deterministic phase

1. Define the decision
2. Identify the alternatives
3. Assign values to outcomes
4. Select state variables
5. Establish relationship at state variables
6. Specify time preference analysis:
    (a) Determine dominance to eliminate alternatives
    (b) Measure sensitivity to identify crucial state variables.

II. Probabilistic phase

1. Encode uncertainty on crucial state variables
   Analysis: Develop a profit lottery
2. Encode risk preference
   Analysis: Select best alternative

III. Post-mortem phase

Analysis: (a) Determine value of eliminating uncertainty in crucial state variables

(b) Develop most economical information-gathering program

To set these three approaches in perspective it seems inappropriate to use "importance" of a problem as the criterion for using decision making, decision theory or decision analysis procedures as the basis for analysis. However, an aspect called "complexity" seems more appropriate. We may, therefore, relegate our most simple problems to the procedures of decision making and our more complex problems to either decision theory or decision analyses procedures, the distinction perhaps being based upon the thoroughness by which the analysis should be completed.

Illustration: Personnel Policy Making with Decision Theory

The problem used here to illustrate the procedures of decision theory is a real problem faced by the Bureau of Naval Personnel. The official title of the project is "Early Identification of Potential Drug Abusers" whose short working title is ID Drug Abuse (Project number 521.005.01.09.). As specified by the Project Director, Target #4, Goal #11 is to "develop predictor scales for use in the selection, identification of good rehabilitation risks and in the evaluation of preventive drug abuse programs." The analysis approach to the scale development is intended to be achieved through the use of the ABCD Technique and CHAROSEL using available record sets from abstainers and two types of drug abusers. For our illustrative purposes we shall restate the project objective to be that of "to determine the 'optimal' personnel policy for handling identified abstainers and drug abusers among enlisted naval personnel." We set up this "straw man" only to illustrate the effectiveness of decision theory for creating personnel policies and to promote such research capability.

The Problem to be Considered

The problem to be considered is that of finding an "optimal" personnel policy. By the word "optimal" we mean here the selection of one of the admissible policies by means of an auxilliary decision criterion. By the term "policy" we mean the specification of an action for each possible value, in the record set Xor a reduced record set.

The Uncertainty Feature

Through the use of the ABCD Technique, all the 139 characters in the record set (consisting of biographical and opinion data information) are reduced to a single decision variable, X, which takes on three values: $X_1 = 1$, $X_2 = 2$ and $X_3 = 3$. These numbers are used to decide if a member is one of three states of nature (Θ). The states are as follows:

Θ_1 = Abstainers from drug involvement
Θ_2 = Minor drug involvement termed "reçreational"
Θ_3 = Hard drug involvement.

The feature of uncertainty is that we are uncertain as to whether or not the X variable correctly identifies the classification of the member.

The Available Information

The available information about Θ is summarized into a single variable called X which can take one of three values. This variable is in fact a summarization of data from a member which consists of 139 biographical items and opinion responses. A biographical item might merely say

> Which of the following alternatives characterizes your homelife situation during early childhood?
>
> 1. Lived with both natural mother and natural father.
> 2. Lived with natural mother only.
> 3. Lived with natural father only.
> 4. Lived in foster home.
> 5. Other.

An opinion item might be

> Marijuana is addictive.
>
> 1. Agree
> 2. Disagree
> 3.

The information, X, specifies a decision, made by the ABCD Technique, as to the classification of the member whose data was used for the record set in the analysis.

The Uncertainty - Information Relation

From our previous studies, we determine probabilities associating the possible states of nature, Θ, with the record set, X. This information has been obtained from a testing sample completely independent of a training sample used to estimate the endorsement ratios $p(X_a^c|\Theta)$. The probabilities are summarized in Table 6.

TABLE 6

Relationship of Record Set and Uncertainty Feature
(Probabilities)

		DECISION CATEGORY		
		X = 1	X = 2	X = 3
TRUE CATEGORY	Θ_1	0.890	0.066	0.044
	Θ_2	0.109	0.783	0.108
	Θ_3	0.063	0.114	0.821

Some Feasible Personnel Actions

When considering what course of action to take with a member identified as one of the Θ's an administrator has a wide variety of actions available to him. For illustrative purposes we have restricted this list to 8 actions specified in Table 7. These actions cover those which first occur to the mind and include the possibility of taking no action or utilizing a composite action composed of simple actions.

TABLE 7

Action Set for Drug Involvement Problem

Action	Acronym	Description
a_1	NULL	Take no action.
a_2	EDUC	Enter man in drug education program.
a_3	TRAN	Transfer man to another non-critical billet.
a_4	THER	Enter man in medical-psychological therapy program.
a_5	PUNI	Threaten or actually punish man with disciplinary measures.
a_6	DISC	Discharge man from naval service.
a_7	REOR	Composite policy combining actions a_2 and a_4.
a_8	REHAB	Composite policy combining actions a_4 and a_6.

The Payoff Matrix

In this problem, as in other decision theory problems, there is a requirement to specify a payoff table which quantifies the value or utility of each possible action for each state of nature. This quantification is a personal one on the part of the decision maker and is sometimes quite difficult. Various schemes for this type of problem have been proposed, including those of von Neumann and Morganstern (1947), Mosteller and Nogee (1951), Howard (1967), and Curtis (1967). The author has also developed a simplified procedure described in Moonan (1973). That payoff table, devised by the project director and staff, appears as Table 8.

TABLE 8

Drug Involvement Payoff Table

Action	Θ_1	Θ_2	Θ_3
NULL	300	300	120
EDUC	395	390	315
TRAN	195	220	380
THER	335	330	320
PUCI	175	220	275
DISC	120	100	250
REOR	190	270	310
REHAB	130	200	390

Some Personnel Policies

Because we have three possible values of the decision variable and 8 possible actions (A), we theoretically have available to us $8^3 = 512$ feasible personnel policies. Of course, we shall not consider all of these here but shall merely specify an arbitrary number, which we take to be 10, as indicated in Table 9.

These 10 policies represent a reasonable consideration of the total 512 policies available.

Policy Worths

It is possible, using Tables 6 and 8 to assess the "worth" of a policy, Π, when the state of nature is Θ_k. The formula for the worth is provided by

$$W(\pi, \Theta_k) = \sum_x U\{d(X), \Theta_k\}\, p(X|\Theta_k) \quad .$$

For example,

$$W(\pi 1, \Theta 1) = 395\ (.890) + 395(.066) + 195(.044) = 386.2 \quad .$$

This, and other worths are indicated in Table 9.

TABLE 9

Some Possible Decision Policies and Their Worths

Policy	Actions	Policy Worth Θ_1	Θ_2	Θ_3	Admissible Policies	$B(\pi,\alpha)$
π_1	a_2, a_2, a_3	386.2	371.9	368.4	*	379.28
π_2	a_1, a_2, a_3	301.6	361.8	355.7		
π_3	a_2, a_2, a_2	395.0	390.0	315.0	*	379.30
π_4	a_1, a_1, a_8	292.5	289.2	341.7		
π_5	a_1, a_2, a_7	301.4	367.2	298.2		
π_6	a_1, a_2, a_6	298.3	348.9	249.0		
π_7	a_2, a_2, a_4	392.4	383.5	315.1	*	376.2
π_8	a_7, a_8, a_5	185.4	209.8	290.4		
π_9	a_4, a_5, a_7	318.1	237.4	306.7		
π_{10}	a_3, a_8, a_8	187.8	202.2	389.4	*	227.8

Admissible and Inadmissible Policies

Inspection of Table 9 shows that we can dismiss, as unsound, some of the 10 policies. For example, policy π_2 has worths which are each smaller than the corresponding worths of policy π_1. Consequently, it would therefore clearly be more valuable to adopt policy π_1 rather than policy $\pi 2$ for any possible state of nature. We use the term inadmissible to describe a policy, π, which is such that, for some other policy π'

$$\begin{aligned} W(\pi, \Theta_1) &\leq W(\pi', \Theta_1) \\ W(\pi, \Theta_2) &\leq W(\pi', \Theta_2) \\ W(\pi, \Theta_3) &\leq W(\pi', \Theta_3) \quad . \end{aligned}$$

with strict inequality for at least one of Θ_1, Θ_2 or Θ_3. As noted in Table 9 policies π_2, π_7, π_5, π_6, π_8 and π_9 are inadmissible whereas we have 4 admissible policies, π_1, π_3, $\pi 7$ and $\pi 10$. Consequently, we have no uniformly best policy and in order to select an "optimal" policy, we either must utilize additional information or appeal to a supplementary decision criterion.

good classification accuracy, a computer can be programmed to list all possible response patterns to the 5 or 6 characters and indicate to field administrators which course of action should be followed for each response pattern.

SUMMARY OF DECISION ANALYSIS PRESENTATION

This section began by noting the contributions of von Neumann, Wald, and Bellman to modern decision analysis and by contrasting the structures of decision making, decision theory and decision analysis, the latter expected to be the primary procedural model for administrative decision making associated with NPRDC personnel research during the next decade.

A particular naval personnel problem was selected to illustrate the structure of decision theory and to provide an educative example for general consideration. It is expected, however, that the more useful model will be the decision analysis model, although they are highly related. The intent of the analysis was to specify a "personnel policy" which could be utilized routinely for handling naval enlisted personnel identified as belonging to one of three states of drug involvement by a technique developed by the author. One concomitant benefit derived from the application of either decision theory or analysis models is that their technical terminology provides a convenient and effective language for conveying the objectives of naval management quickly and effectively to personnel research workers.

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RECENT AND PROJECTED DEVELOPMENTS

IN

ABILITY TESTING BY COMPUTER

James R. McBride

and

David J. Weiss

A wide variety of conventional paper-and-pencil ability tests is employed in military and industrial settings to provide information needed for personnel selection and placement decisions. Even the best test or battery represents a compromise to some degree. Long tests, or batteries of shorter tests, provide fairly precise information at the expense of testing time. Shorter tests require less time, naturally, but provide relatively imprecise information about persons.

Errors of measurement or of classification are potential sources of waste of money or loss of organizational effectiveness; this statement's truth value probably increases as a function of the size of the organization, and has obvious implications for an organization the size of the Navy. The armed services--or any large industry--have a vested interest in improved personnel testing from an economic point of view. Social considerations today require that interest to be extended to a social viewpoint as well; people, as well as the organization, need to be considered. In the past, paper-and-pencil standardized group tests have served employing organizations fairly well, from the dollar-and-dimes viewpoint--but improvement would certainly not be unwelcome. Today, as in the past, such tests are under scrutiny by persons seeking to upgrade their "fairness" to individuals, and to minority groups within the society. Criticism from these quarters is not often psychometrically or statistically sophisticated--neither is it always unfounded--but its sheer volume may be compelling.

Any consideration of how standardized tests may be improved--from either the psychometric or the social viewpoint--ought to consider their general limitations. One weakness of such tests is the requirement for a human administrator: humans vary; administrator variability along certain dimensions has been suggested to have differential effects on examinee performance (Mandler & Sarason, 1952). Another problem is the answer sheet, which has been shown to affect performance in several ways, differentially for different groups (Gordon, 1958; Hayward, 1967; Clark, 1968; Nitardy, Peterson, and Weiss, 1969). The sequence of presentation of test items in terms of the difficulties of the items, and the presence of time limits have both been found to affect test performance differentially across anxiety levels, and thus probably across ability (Klosner & Gellman, 1971; Sax & Cromack, 1966; MacNichol, 1956).

The strength of the standardized paper-and-pencil test lies in its constancy: it may be thought of as a set of highly standardized stimuli to which the examinee must respond. In that strength resides a limitation also. To the extent that the level of difficulty of a test is inappropriate for the ability levels of some examinees, the quality of the resulting measurements must be questioned. Boredom, fatigue, and guessing effects are all hypothesized to be related to the degree to which test difficulty deviates from individual ability (Nunnally, 1967). Several researchers have concluded that the precision of measurement is not independent of score level (Baker, 1964; Lord, 1957, 1959, 1970); but precision is dependent, at least in part, on the true ability level of the examinee relative to the ability level of the test (Lord, 1970, 1971a, b, c, d). Furthermore, standardized tests are generally constructed to yield a specified distribution of scores within the standardization group. Such tests may not be sensitive to the distribution of the underlying ability in other populations, or may have their utility restricted by constructing them to yield, say, a normal distribution.

An adaptive test--a test that tailors itself to the ability of the examinee, which does not try his patience with too many easy items, nor his imagination with too many overly difficult ones, nor his stamina with just plain too many items--ought to be fairer to the individual and should yield more accurate measurement of abilities which deviate from the mean (Lord, 1970, 1971a, b, c, d). The state of the art in computer science today permits such a test to be administered by a computer. Computer administration offers all the advantage of adaptive testing, can eliminate such sources of error as administrator variables, answer sheets, and time limits, and yet retains the standardized stimulus and objective scoring of conventional tests.

During the remainder of my discussion this morning, I will present to you five different strategies for adapting the test to the individual. I will consider, rather briefly, the rationale, advantages and weaknesses of each, and the research which has been done on each, then go on to describe briefly the program of computerized testing research being conducted under ONR support at Minnesota.

Strategies of Adaptive Testing

The adaptive testing strategies with which our research is concerned can be broken down into five general categories. Within each category is a very wide latitude for variations on the general theme. The five, as we have named them, are:

A TWO-STAGE TEST

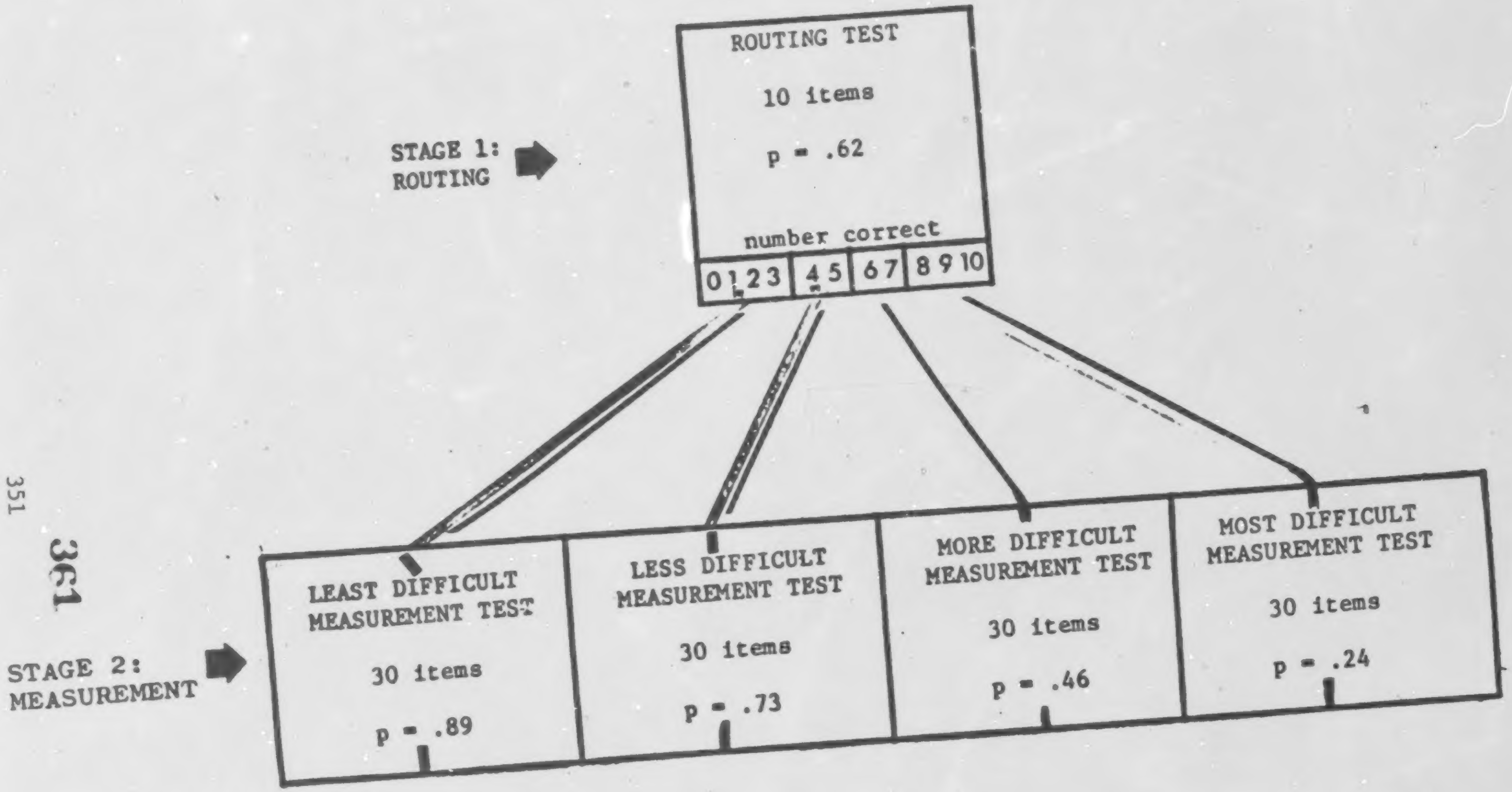
STAGE 1:
ROUTING
ROUTING TEST
10 items
p = .62
number correct
0 1 2 3
4 5
6 7
8 9 10
STAGE 2:
MEASUREMENT
LEAST DIFFICULT MEASUREMENT TEST
30 items
p = .89
LESS DIFFICULT MEASUREMENT TEST
30 items
p = .73
MORE DIFFICULT MEASUREMENT TEST
30 items
p = .46
MOST DIFFICULT MEASUREMENT TEST
30 items
p = .24

FIGURE 1. Schematic diagram of a simple two-stage adaptive test. Stage 1 is a 10-item routing test. Stage 1 score determines which of four 30-item measurement tests the examinee will take at stage 2.

1. two-stage tests
2. flexilevel tests
3. pyramidal models
4. Bayesian strategies
5. the stratified test

What distinguishes one from another is the logic by which subsequent test items are selected for presentation to a testee.

Two-stage

The simplest adaptive testing strategy is the two-stage model. Essentially this consists of two sub-tests to be administered to any testee. On the basis of his score on the first test, the examinee is classified roughly as to his ability level. Following classification he is administered a second test, this one appropriate to the general level of ability at which he has been classified. Figure 1 schematically illustrates a two-stage testing strategy. Stage 1 is a 10-item routing test. Stage 2 has four "measurement" tests, each appropriate to a different level of ability. A score of 0, 1, 2 or 3 on stage 1 results in being administered the easiest measurement test. An 8, 9, or 10 on the stage 1 test routes the testee to the most difficult test, while scores of 4, 5, 6, or 7 route to the measurement tests of intermediate difficulty. It should be noted here that the examinee does not observe this routing process. Under computer administration it is done automatically, with no discernible interval between stages. In the case illustrated here, forty items are administered sequentially to any testee as though they were one test.

The routing test may be of any desired length, of course; nor is there any arbitrary restriction as to the number of levels of measurement tests. Practical considerations provide the only constraints.

The first reported study of two-stage testing was that of Angoff and Huddleston in 1958. While Angoff and Huddleston did not actually route testees, their design was such that the effects of routing could be studied as if it actually occurred. They used 40 and 30 item verbal and mathematical routing tests, to route to one of only two slightly shorter narrow-range measurement tests. In other words in two different ability domains, they classified examinees as high or low, and administered the appropriate level of measurement test. They compared their results with conventional "broad range" ability tests, and found the narrow range tests to be more reliable for the appropriate level groups than were the broad range tests. They also found slightly higher validities for the narrow-range tests than for the broad range tests, using college GPA as a criterion.

Cleary, Linn and Rock, in a series of related papers, reported the results of some "real data" simulations of four different two-stage strategies. They used the responses of 4885 students to the 190 verbal items of the SCAT and STEP tests; these they analyzed as if each of the four adaptive strategies had been used, employing subgroups of the same items. Results were reported in terms of correlations with scores on the parent test (Cleary, Linn and Rock, 1968 a, b) and in terms of correlations with an external criterion (Linn, Rock and Cleary, 1969)--scores on two well-established conventional tests taken a year later. Without going into detail on the four strategies, let me summarize some results of particular interest here. One finding was that the much shorter two-stage test correlated highly enough with total score on the parent test to suggest that drastic reductions in test length could be made with little or no loss of accuracy of measurement (Clery, Linn, and Rock, 1968b). To achieve the same accuracy as their best strategy, a standard test would require a minimum of 35% more items. The Linn group's validity studies against the external criterion were even more favorable to the two-stage procedures (Linn, Rock, and Cleary, 1969). In general these studies by Cleary, Linn & Rock agree with the results of Angoff and Huddleston's study. The adaptive procedures appeared to result in higher reliabilities, higher correlations with parent tests, and higher validities against external criteria than conventional tests of the same length.

A theoretical study by Frederic Lord (1971d) of "over 200 two-stage testing procedures" produced the findings, under rather rigorous formal assumptions, that the best two-stage procedure provides almost as much "information" as a standard peaked test does at the mean ability level, and that as ability deviates from the mean the two-stage procedures yield better measurement, with the advantage increasing with the amount of deviation.

One problem unique to the two-stage strategies is that of mis-routing, or errors of classification. Both Angoff and Huddleston, and Linn *et al.*, experienced about 20% misclassification by the routing tests.

Multi-stage Fixed Branching Models

Two-stage tests are conceptually the simplest adaptive tests. One way of looking at them is as a two-stage fixed branching procedure. Slightly more complex in structure are what may be called the multi-stage fixed branching strategies, two of which I shall discuss: the flexilevel design and the pyramidal, or tree-structure designs.

Flexilevel tests

I have already mentioned that one potential benefit of adaptive tests is reduction in test length. The flexilevel test, developed by Frederic Lord of Educational Testing Service (1971a) essentially uses a fixed branching procedure and a fixed number of items to estimate the examinee's score on a test consisting of double the number of items he has encountered.

Figure 2 illustrates the construction of a flexilevel test in which each examinee will answer exactly eight items. The test is composed of fifteen items arranged in order of difficulty. Item 1 is the easiest item in the test, item 2 is slightly more difficult, and so on up to item 15, the most difficult item. Each item is more difficult than the one preceding it by some fixed increment of difficulty, called the step size. Item 8 is the item of median difficulty and everyone is administered this item first. Think of item 8 as the first stage of a sequential procedure. At every stage, correctness of item response determines the next item to be administered. Every time an item is answered correctly, the examinee is routed to the next more difficult item not already encountered. Answering incorrectly routes him to the next less difficult item not yet taken. The procedure terminates when he has answered eight items.

Figure 3 indicates the progress of three hypothetical examinees through the test, along with the scores they would be assigned by one scoring scheme. Under this scheme, which is too intricate to go into here, there are exactly 16 possible scores obtainable on the basis of 8 stages. In other words, the same number of discriminations among examinees is possible as would be possible in a 15-item conventional linear test, but only 8 items are actually administered to any testee.

Lord (1971c) performed a theoretical comparison of a 60-stage flexilivel test, a 60-item conventional peaked test and a linear test designed to discriminate at two points on the ability continuum. His analyses found that the flexilevel yields more information throughout the ability range than does the test designed to discriminate at two points. The conventional peaked test provided more information around the mean, but the flexilevel was superior beyond 1 standard deviation from the mean. In other words, the flexilevel test yielded more accurate measurement for the 30% of the population in the tails of the assumed normal distribution.

Lord's findings, of course, are theoretical and not generalizable beyond the rather restrictive assumptions under which they were obtained. Nonetheless, the flexilevel test represents a savings of approximately 50% of testing time--a benefit sure to inspire empirical investigations of its practical utility.

One objection to Lord's flexilevel was that it is proposed as a paper-and-pencil test requiring a self-correcting answer sheet and an elaborate set of instructions. This objection is overcome by computer administration of it, which requires nothing of the examinee except his item responses.

A more cogent objection to the flexilevel scheme is its rectangular distribution of item difficulties, with only one item at each difficulty level. Since the order of arrangement of the items is all-important, minor errors in item scaling may cause undetectable deviations from the theoretical psychometric structure of the test, which would constitute a source of error variance. A further restriction in the flexilevel model is that all items have equal discriminating power--a specification that is difficult to fulfill

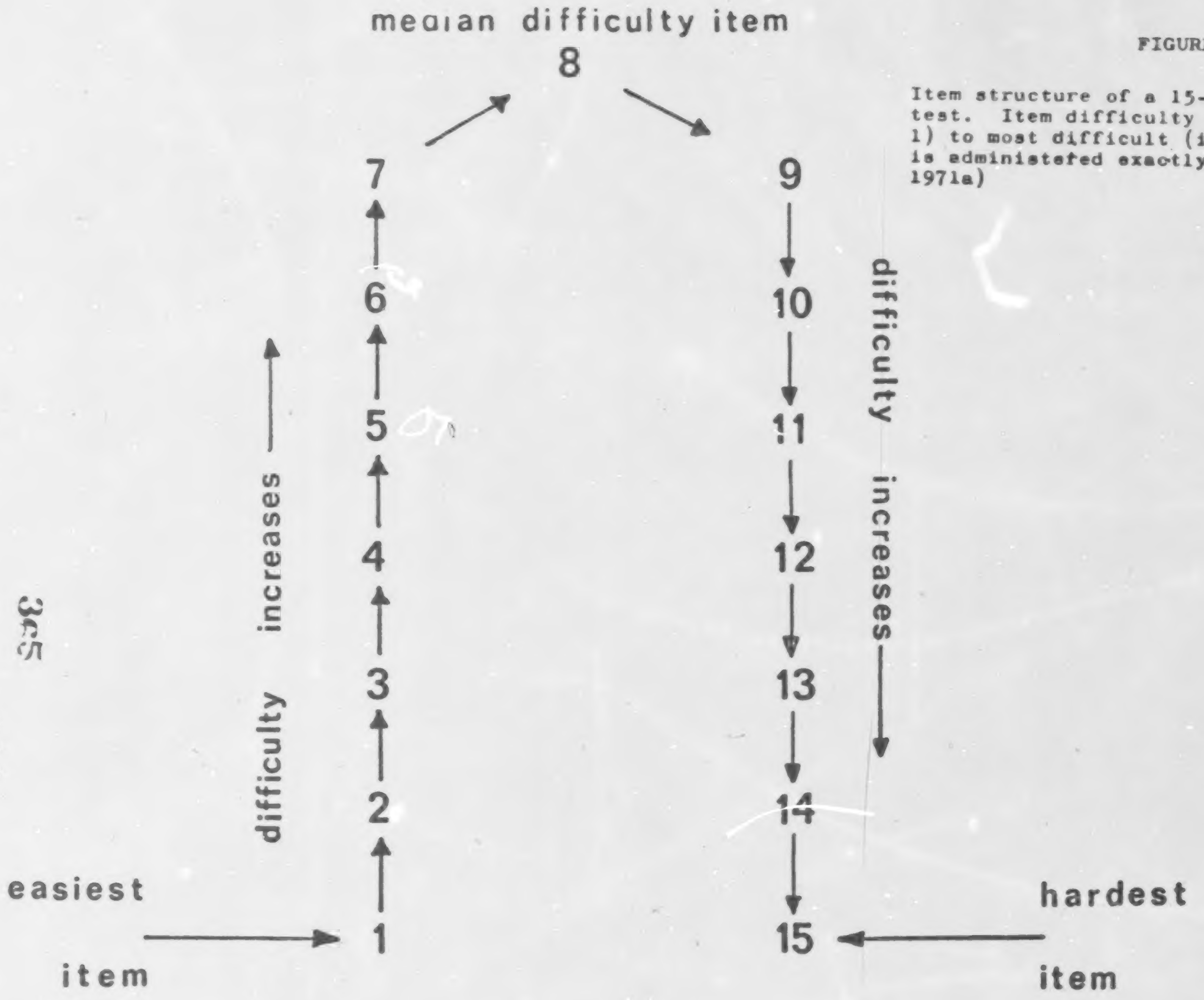
median difficulty item
8
7
6
5
4
3
2
1
9
10
11
12
13
14
15
difficulty increases
difficulty increases
easiest item
hardest item

FIGURE 2.

Item structure of a 15-item (8 stage) flexilevel test. Item difficulty ranges from easiest (item 1) to most difficult (item 15). Each examinee is administered exactly 8 items. (after Lord, 1971a)

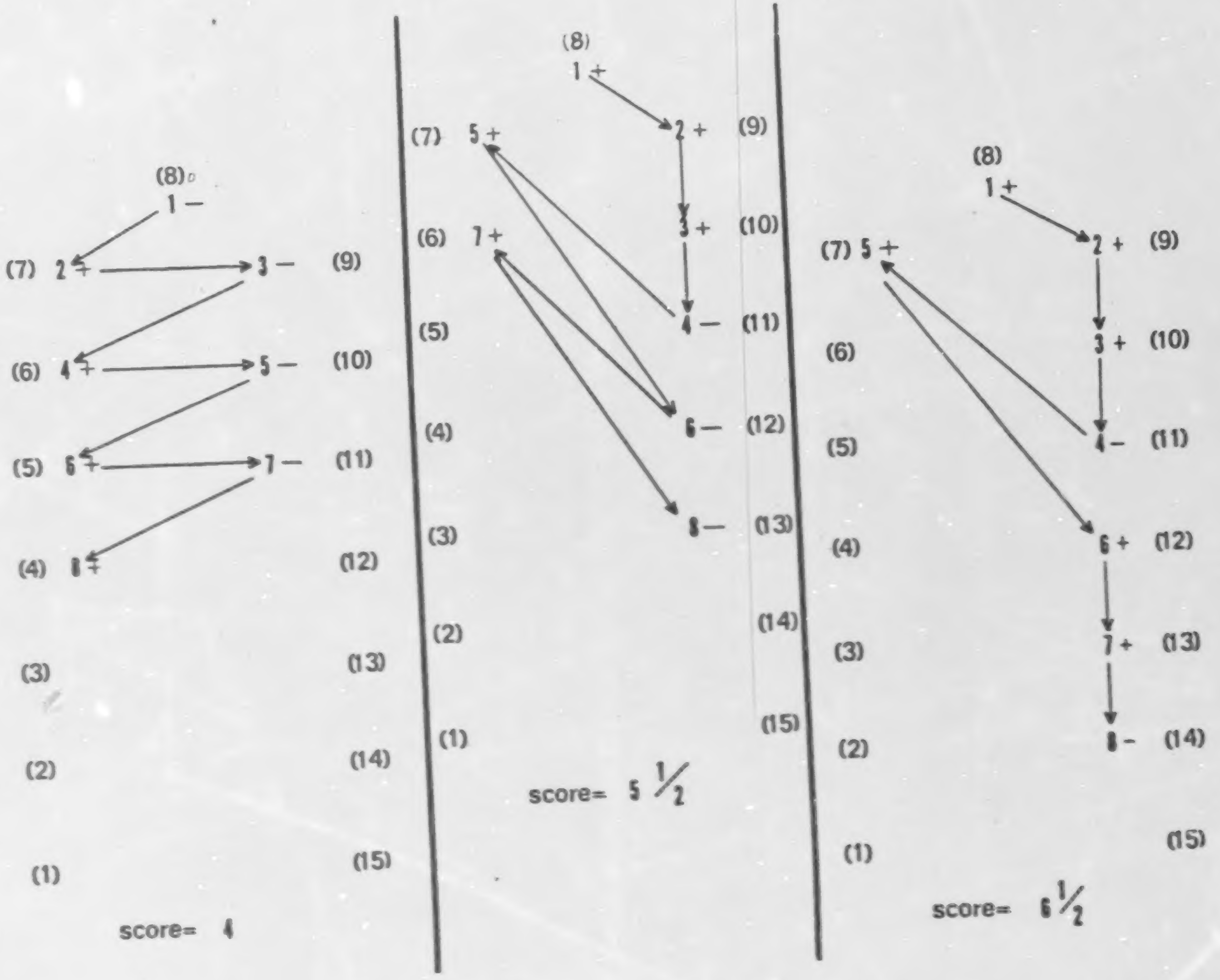
(8)
1 −
(7) 2 +
3 −
(9)
(6) 4 +
5 −
(10)
(5) 6 +
7 −
(11)
(4) 8 +
(12)
(3)
(13)
(2)
(14)
(1)
(15)
score= 4
(8)
1 +
(7) 5 +
2 +
(9)
(6) 7 +
3 +
(10)
(5)
4 −
(11)
(4)
6 −
(12)
(3)
8 −
(13)
(2)
(14)
(1)
(15)
score= 5 1/2
(8)
1 +
(7) 5 +
2 +
(9)
(6)
3 +
(10)
(5)
4 −
(11)
(4)
6 +
(12)
(3)
7 +
(13)
(2)
8 −
(14)
(1)
(15)
score= 6 1/2

FIGURE 3. Routing of three hypothetical examinees through a 15-item (8 stage) flexilevel test. The numerals in parentheses (1-15) correspond to item number; the inner numerals (1-8) indicate stage number. "+" alongside the stage number indicates a correct response at that stage; "-" indicates an incorrect response. The scoring formula is developed in Lord (1971a).

in actual test construction.

Pyramidal Models

An adaptive test design that comes closer to overcoming some of the deficiencies of the flexilevel test is the pyramidal test. A simple pyramidal design is shown in Figure 4. This one has ten stages, for illustrative purposes. Each stage is represented by a horizontal row of items, each shaded block represents an item, and each column represents a difficulty level. The easiest items are at the left of Figure 4 with each level to the right being a more difficult one. Like the flexilevel, this design features a fixed number of stages, with one item administered per stage. But in the pyramidal model the distribution of item difficulty is not rectangular but unimodal and symmetric.

Each examinee begins the test with an item of median difficulty. At each stage the correctness of his response determines the routing. Three hypothetical examinees' performances are depicted in Figure 4. Note that a correct answer at any stage routes the testee to the next more difficult level at the next stage. An incorrect response sends him to the next easier level. Testing terminates when there are no more stages to progress through.

The relative complexity of the pyramidal design makes possible an almost endless number of variations on the theme. These can be considered in terms of step size, offset, number of items per stage, branching algorithms, termination rules and scoring formulae. Step size refers to the difficulty increment between two adjacent difficulty levels. This may be constant, or may vary as desired. Offset refers to the number of levels crossed from one stage to another. The simple design illustrated in Figure 4 used an "up-one, down-one" offset formula, but some other formula might have been employed--for example "up-two, down-one," in which a correct answer routes the examinee two levels up, but a wrong answer routes him down only one level.

Some pyramidal designs utilize two or more items per stage, with subsequent routing prescribed in terms of the number right at that stage. In such a design a manifold branching algorithm might be employed--with three or more branches at each stage rather than the two shown in our example. Another branching algorithm might be based on which wrong answer was given to a multiple choice item. It should be obvious by now that considerable complexity is available among the multi-stage, fixed branching adaptive test designs, of which the simple pyramid is the basic example.

Another source of complexity is the multiplicity of scoring schemes available for pyramidal tests. Figure 5 illustrates the progress of an actual examinee through a 15-stage simple pyramidal test of verbal ability. Below the diagram are the scores that would be assigned the examinee using only a few of the scoring schemes that have been proposed. Each scheme has

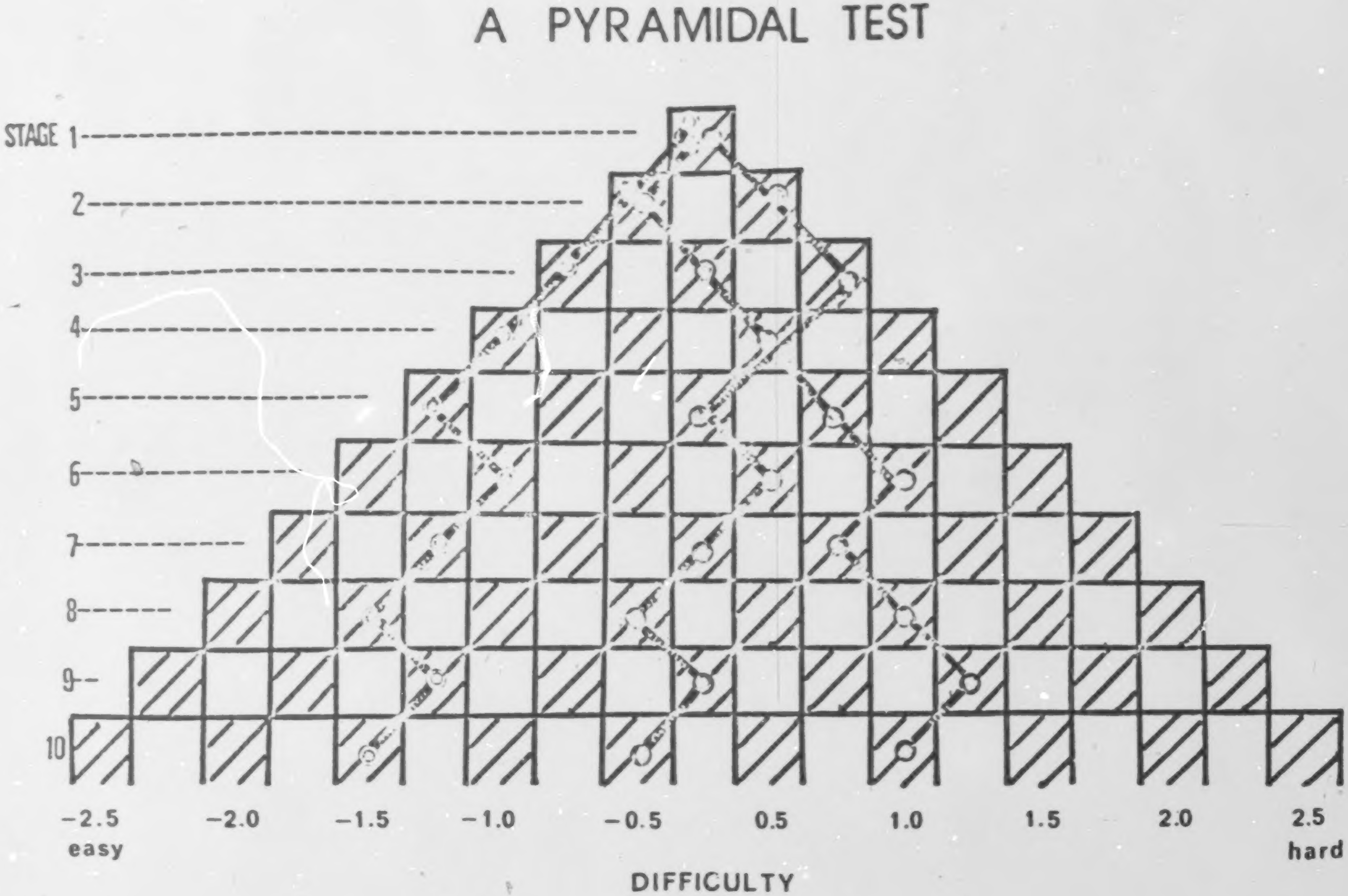
A PYRAMIDAL TEST
STAGE 1
2
3
4
5
6
7
8
9
10
−2.5
easy
−2.0
−1.5
−1.0
−0.5
0.5
1.0
1.5
2.0
2.5
hard
DIFFICULTY

FIGURE 4: A 10-stage pyramidal adaptive test structure. Each shaded block represents an item. Three examinees' routings are depicted.

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                    REPØRT ØN PYRAMIDAL TEST

ID NUMBER:    554911                          DATE TESTED:   73/04/09
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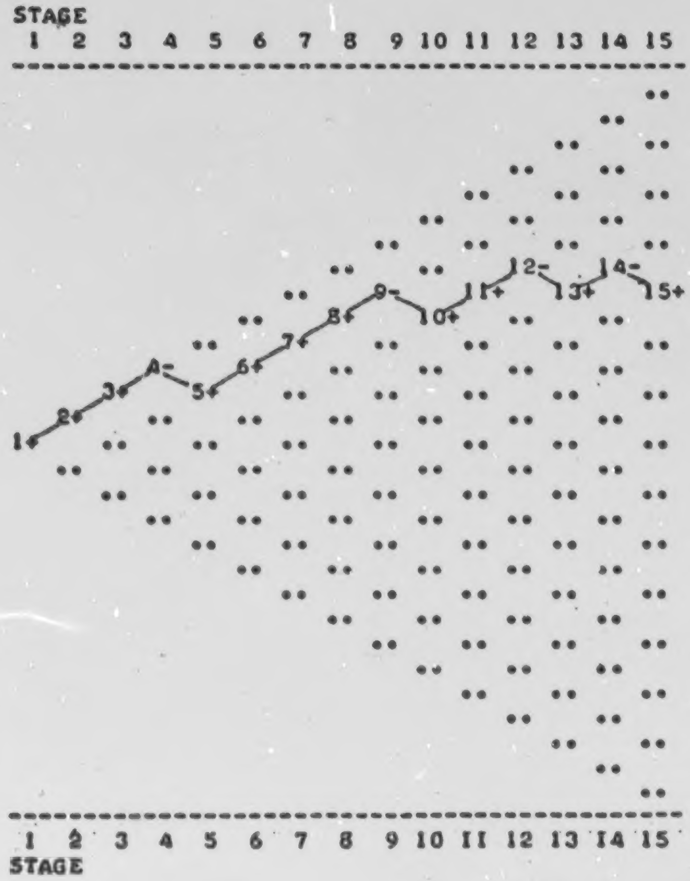

```
THERE WERE 11 CØRRECT ANSWERS.

THESE HAD A MEAN DIFFICULTY ØF    .6313545

THERE WERE 15 ANSWERS IN TØTAL.

THESE HAD A MEAN DIFFICULTY ØF    .7515267

THE FINAL ITEM HAD A DIFFICULTY ØF  1.0052000

THE DIFFICULTY ØF THE (N+1)ST ITEM IS  1.32960
```

FIGURE 5. The progress of a live examinee through a 15-stage simple branching pyramidal adaptive test. "+" indicates a correct response; "-" indicates an incorrect response. Each row of dots corresponds to a single difficulty level, with the most difficult level at the top of the figure. Scores resulting from 5 different scoring schemes are listed below the figure.

its merits and its demerits. Which is "best" remains an empirical question whose answer may vary with the application of the test. One pyramidal scoring technique uses the difficulty rank of the final item reached. In this 15-stage design there are only 15 unique scores possible under that scheme. A variation of this uses the final item score (correct vs. incorrect) information, which doubles the number of ranks. Another similar method assigns scores on the basis of the difficulty level of the $(n+1)^{th}$ item--the item that would be presented contingent on the final item response on a 15-stage test, 16 unique scores are assignable under this method. Other scoring schemes are based on weighted average item difficulties: for instance the average difficulty of all items attempted; that of all items correct; or a weighted average of some sort.

Research on Fixed-branching Models

Despite the considerable variety of approaches to adaptive testing based on fixed branching models, research to date has yielded consistent enough results that a tentative conclusion can be drawn regarding the utility of these approaches. Some of the early work in the field used paper-and-pencil tests modified to permit multi-stage branching. The earliest reported research was by Krathwohl and Huyser (1956), who found a correlation of .78 between an 8-item branched test and a 60-item parent test--suggesting that testing time could be markedly reduced with only moderate loss of information. Later paper-and-pencil branched tests used by Bayroff and others (1960), and by Wood (1969) failed to show an advantage for the adaptive tests, but each of these studies had deficiencies which limits the generalizability of the results (Weiss and Betz, 1973). One of these problems was the paper-and-pencil format, which required close adherence to a complex set of instructions, possibly confounding the test scores with a component unrelated to the ability being measured.

Both Bayroff and Wood subsequently used computer administration of similar tests, with more favorable results. Bayoff and Seeley (1967) reported corrected correlations of .83 and .79 between two 8-stage branched tests and much longer conventional tests drawn from the same pool. Another finding of interest was a reduced intercorrelation between verbal and numerical tests. Under paper-and-pencil administration these tests intercorrelated .65; computer administration reduced the correlation to .57, suggesting that method variance was reduced under computer administration. Another notable result was the distribution of numerical test scores. On the branched test, the distribution of scores was skewed negatively--a large proportion of subjects' scores fell into the high end of the distribution (N=102). Maximum scores were obtained by individuals whose scores on the corresponding conventional test spanned two standard deviations. This may be due to a reduction of some error variance component by the adaptive administration.

Other studies of adaptive testing procedures have investigated the characteristics of pyramidal models and their derivatives, using empirical data, simulation, and theoretical analyses. In general their results show a distinct advantage for the adaptive tests in terms of test length. The better-designed branched tests correlate higher with parent tests than do conventional tests of the same length. Hansen (1969) and Linn, Rock and

Cleary (1969) found the adaptive tests to correlate higher with external criteria, requiring as few as half the number of items as a conventional test to achieve the same validity. In terms of the distributions of test scores, multi-stage branched test scores typically have yielded differently shaped distributions than conventional tests, better approximating an equidiscriminating rectangular distribution (Hansen, 1969), and more sensitive to the distributions of underlying ability (Paterson, 1962).

Chief among the disadvantages of multi-stage branching tests is their general requirement for very large item pools relative to the length of the administered tests. A 10-stage simple pyramid, for example, requires 55 items; a 15-stage pyramid, 120 items. The requirement becomes prohibitive as the test approaches rather moderate length.

One solution to this problem--only a partial solution at that--was put forth by Mussio (1972) using "retaining barriers" and "reflecting barriers," which essentially amount to truncating the pyramid beyond specified parameters of item difficulty. Mussio's ideas have other merits more relevant to measurement, but space does not permit developing these here.

Variable Branching Multi-stage Strategies

All of the adaptive strategies discussed thus far share several characteristics: a rigidly structured item pool; a fixed and unvarying branching rule; a termination rule based (usually) on a specified and fixed number of items administered. That combination makes it possible to administer tests by an automaton --a mechanical device--as well as by a computer. Contrasted with these fixed-branching strategies are the multi-stage variable-branching strategies, of which I shall discuss only one--a Bayesian strategy. Variable branching methods, generally, are not adaptable to mechanical administration. They require a pool of items of known parameters, but not a structured pool; they use a variable branching rule to select the next item to be administered; and they generally use some statistical criterion--rather than the number of items administered--as a termination rule.

Bayesian Models

Although variable-branching strategies may be non-Bayesian, a Bayesian strategy proposed by Owen (1969, 1970) will serve as an example for our purposes. This strategy, as well as others of the genre, is called Bayesian by virtue of its reliance on Bayes' Theorem for estimating an examinee's ability. More precisely, they calculate a posterior ability estimate at each stage of testing, on the basis of a prior ability estimate and the examinee's item response performance at that stage.

Under the Owen model, as implemented in our testing at the Unversity of Minnesota, nine variable entry points are used. Associated with each entry point is a prior estimate of ability, and a variance of that estimate. On the basis of those two parameters, an item is selected for administration;

that item is the one which will minimize an expected posterior loss function. The examinee's item response is scored, and the posterior ability estimate and its variance are calculated. The posterior estimate at stage 1 becomes the prior estimate at stage 2, and another item is selected and administered. This procedure continues until the variance of the posterior ability estimate converges to some arbitrary small value. At that point testing is terminated. An ability estimate has been obtained which is accurate to some previously specified degree.

Figure 6 depicts the course of two hypothetical examinees through a Bayesian adaptive test. The ability estimates at each stage are represented by the dot on the horizontal continuum. The variance of each estimate is represented by the width of the corresponding distribution. Note that the two examinees begin at different points, therefore encounter different items, and require different numbers of items for convergence to a final ability estimate.

Figure 7 is a computerized report of an actual Bayesian test of verbal ability administered in our research program. Successive stages are represented vertically. The first stage ability estimate and its standard deviation are represented by the uppermost dotted band; subsequent stages follow in order beneath the first. The empirically obtained data represented in Figure 7 provide an excellent illustration of the convergence process resulting from this Bayesian ability testing strategy.

Using a different procedure for item selection, Novick (1969) developed a Bayesian adaptive testing model based on classical test theory. His research findings led him to suggest that Bayesian procedures would be particularly useful for tests of 15 to 20 items. Wood (1971) used Owen's Bayesian model in research which included empirical testing as well as simulation. His findings corroborated Novick's suggestion. Generally, the Bayesian procedure accomplished 85% reduction of the error of estimate within the first 20 items administered. As compared with conventional testing procedures, the Bayesian procedure required 35% fewer items to achieve the same effectiveness.

A Maximum Likelihood Model

Urry (1970) worked with a non-Bayesian multi-stage variable branching model, using monte carlo simulation. His model involved developing maximum likelihood estimates of ability, and the variance of those estimates, following each test item administered. Urry's comparison of adaptive and conventional testing resulted in a number of suggestions for adaptive test design. Space limitations prohibit developing these ideas here. Suffice it to say that under certain assumptions regarding test construction, his results showed that a short adaptive test can yield higher validities than a much longer peaked conventional test. Under the most favorable conditions the reduction in test length approached 90%. The small body of research to date on multi-stage variable branching models for adaptive testing generally

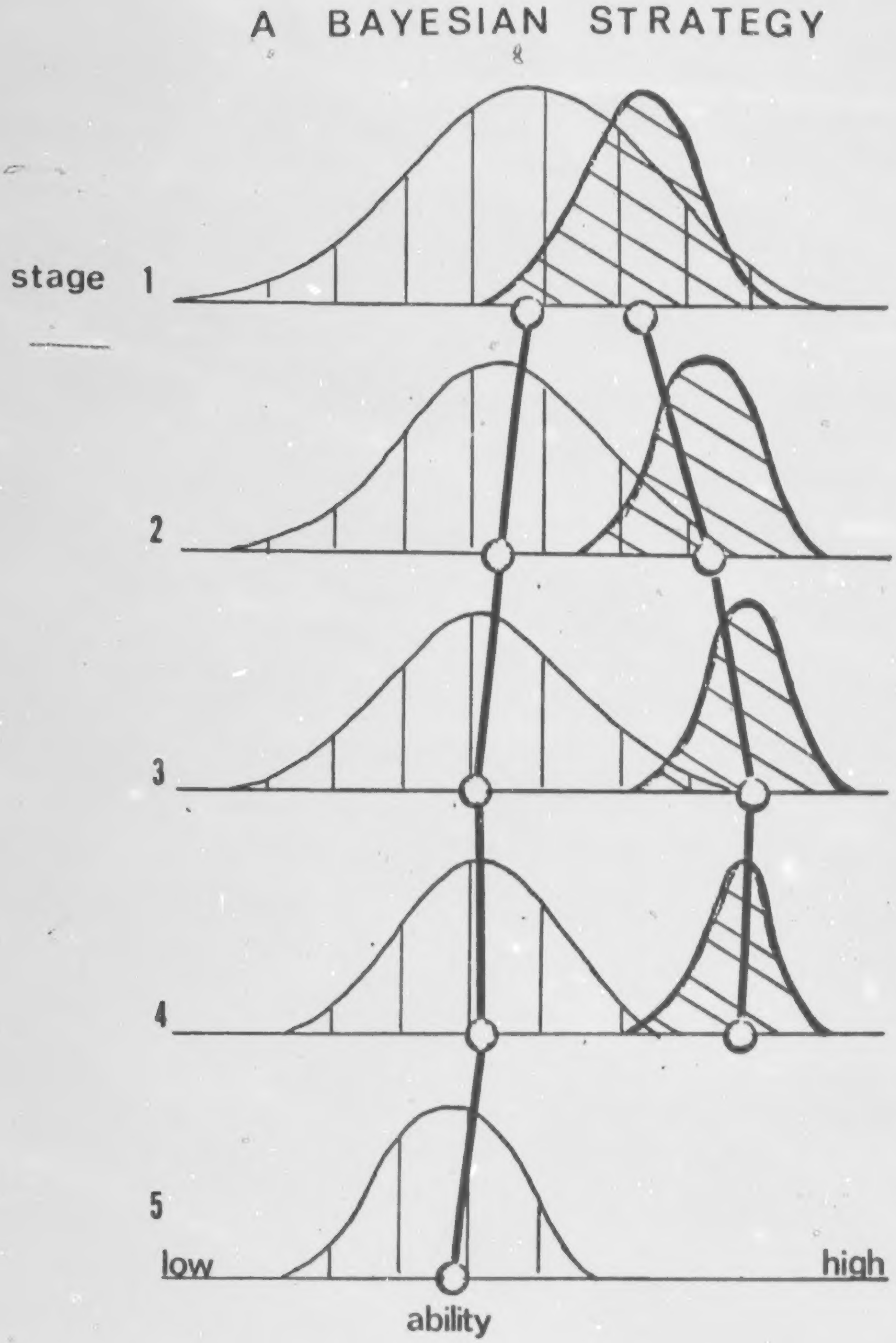
A BAYESIAN STRATEGY
stage 1
2
3
4
5
low
high
ability

FIGURE 6: Diagrammatic representation of a Bayesian adaptive strategy. Two examinees' performances are represented. Depicted by the location and relative width of the distributions at each stage (1-5) is the reduction of the variance of the ability estimate at each stage.

```
                      REPORT ON BAYESIAN TEST

ID NUMBER:      2067                      DATE TESTED:  73/05/03

X=CØRRECT  Ø=INCØRRECT  ERRØR BAND PLØTTED IS + AND - STANDARD DEVIATIØN

                         ABILITY LEVEL                          ABILITY
   -2.5 -2.0 -1.5 -1.0 -0.5  0.0  0.5  1.0  1.5  2.0  2.5      EST   SD
I----I----I----I----I----I----I----I----I----I----I----I----I

                 ..............O..............                 .17 1.41
           .........X.........                                -.93  .98
                  .......X.......                             -.42  .78
                      ......O......                           -.16  .68
                   ......X......                              -.42  .61
                       .....O.....                            -.12  .55
                      .....O.....                             -.29  .51
                     ....O....                                -.45  .48
                    ....X....                                 -.60  .46
                     ....O....                                -.50  .44
                   ....O....                                  -.61  .42
                  ....O....                                   -.72  .41
                  ...O...                                     -.88  .39
                ...O...                                      -1.01  .37
               ...O...                                       -1.16  .35
             ...X...                                         -1.33  .32
              ...X...                                        -1.25  .32
                ..X..                                        -1.19  .30
                ..X..                                        -1.13  .30
```

FIGURE 7. Graphic summary of the performance of a live examinee on a Bayesian adaptive test, illustrating convergence on an ability estimate and stepwise reduction of the variance of the estimates. Ability estimate (EST) and its standard deviation (SD) at successive stages are listed at right.

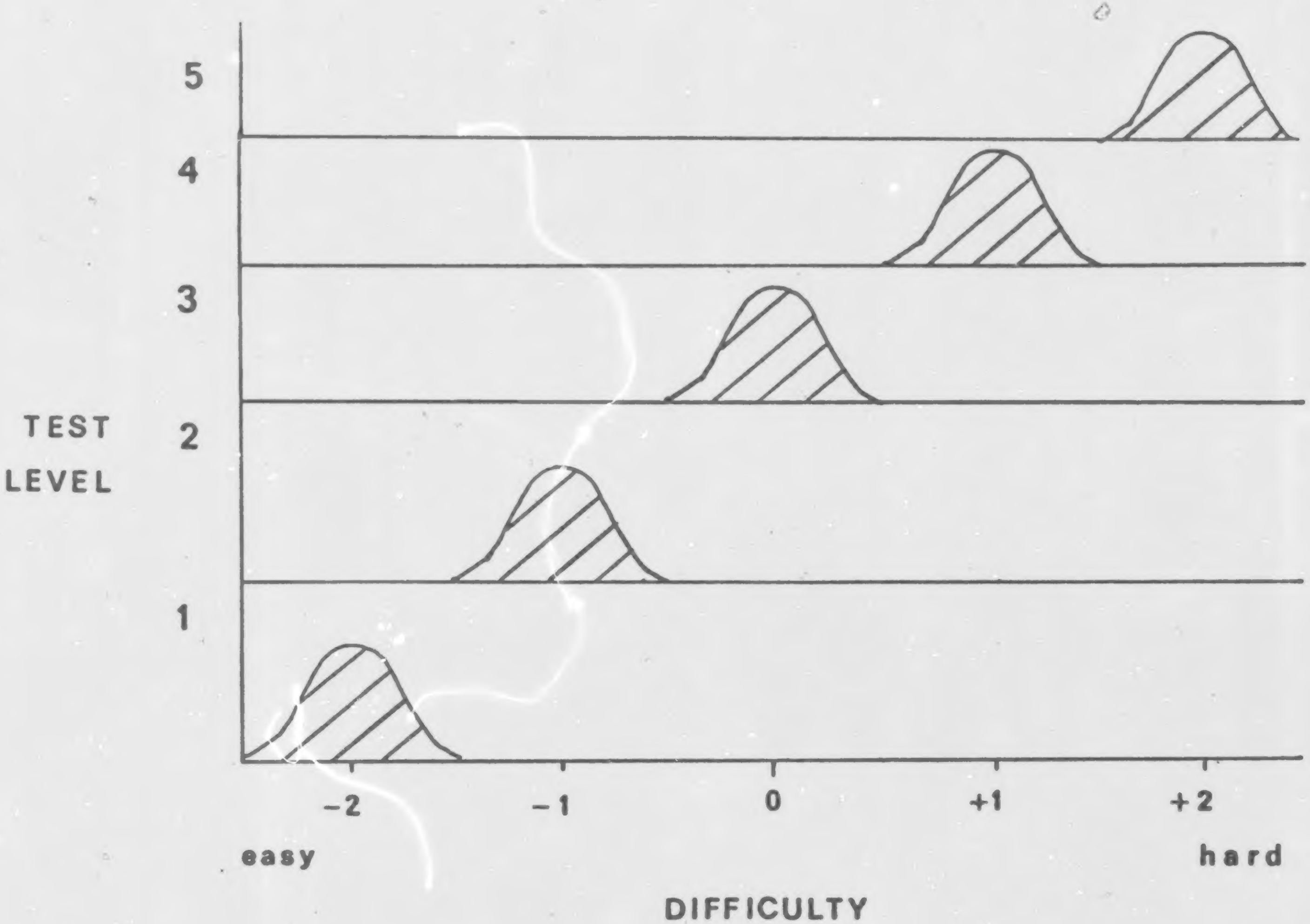

FIGURE 8. The distributions of item difficulty parameters at each level of a 5-level stratified adaptive test. Height of the curve at each level corresponds to number of items.

confirms that they promise significant reduction in test length, if implemented, from that required by conventional tests.

Limitations.

There are some problems inherent in the Bayesian strategies; some of these are common to the non-Bayesian strategies as well. The mathematics of the ability estimation procedure is complex enough that convergence, while it generally occurs within 20 items, may require considerably more in a few cases. Rarely, convergence may not occur under certain models. The same mathematical considerations require these procedures to be implemented by computer, while the simpler fixed branching techniques lend themselves to administration by less sophisticated devices. Another matter is relevant to the state-of-the-art context in which this paper is presented. Most of the research results available to date were based on theoretical work or computer simulation studies. The minimal amount of empirical work done limits confidence in the generality of those results. The solution to the shortage of empirical data is obvious; several empirical studies of a Bayesian adaptive strategy are being conducted at Minnesota. Others are needed.

The Stratified Adaptive Test

The two-state, flexilevel, and pyramidal adaptive models mentioned earlier all are subject to errors of ability estimation caused by chance responding. In general the resulting ability estimates will be irrecoverably inflated or diminished in magnitude by chance correct or incorrect responses. The Bayesian adaptive model, since it uses a statistical criterion rather than the number of items as a termination rule, is not as subject to random influences. To a greater degree than the other procedures, its convergence method permits recovery from errors of chance responding--whether it be guessing or a chance "miss."

The stratified adaptive test, developed by the present authors (Weiss, 1973), combines the simplicity of the fixed-branching models with the flexibility of the variable-branching ones. The stratified adaptive test is essentially a multi-stage fixed branching procedure in which branching occurs not between a fixed structure of items but between difficulty levels, and the termination rule is based on a statistical criterion.

Figure 8 illustrates the structure of a typical stratified test. This one has five levels of difficulty, or strata. Level 1 is the easiest level, and consists of a fixed number of items having approximately uniform difficulty parameters. All the items at level 2 are more difficult than any item at level 1; and so on up through level 5. The items within each level are arranged in decreasing order of their discrimination indices. Ideally, each level of the stratified test consists of a peaked test. The branching procedure, in essence, seeks to route an examinee to the peaked test whose difficulty level is appropriate to his ability.

REPORT ON STRATIFIED TEST

ID NUMBER: 724176 DATE TESTED: 73/07/02

DIFF. LEVEL: 1 2 3 4 5 6 7 8 9

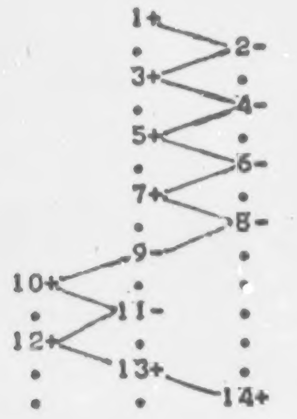

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FIGURE 9. The relatively consistent performance of a live examinee on a stratified adaptive test of word knowledge. "+" indicates a correct response; "-" indicates an incorrect response. Stage number precedes the item response. The ability level appropriate to this examinee (Level 6) was identified in 14 stages.

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                REPØRT ØN STRATIFIED TEST

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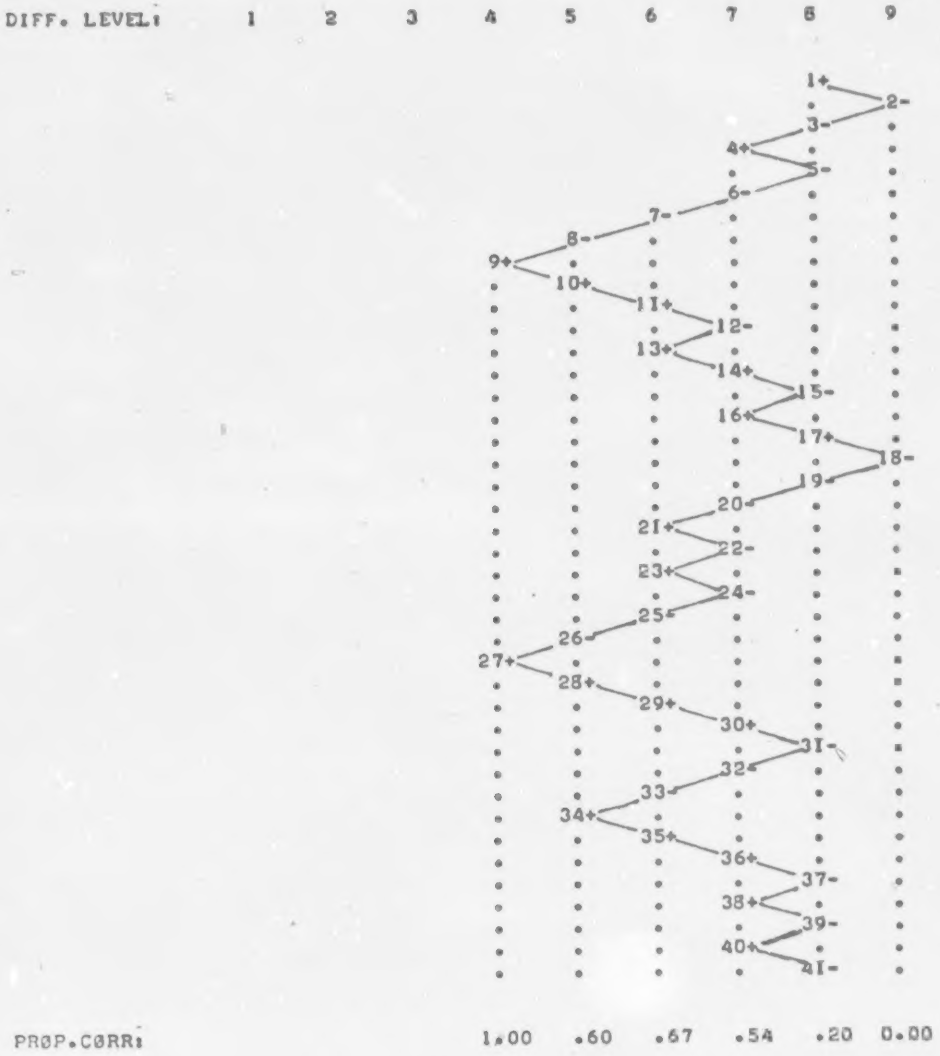

FIGURE 10. An empirically observed inconsistent performance on a stratified adaptive test of word knowledge. 41 stages were required to identify the ability level appropriate to this examinee. (See Figure 9 for meanings of the symbols used.)

As presently conceived, the stratified test uses variable entry levels. Prior knowledge about the examinee--or perhaps his self-report--determines the difficulty level of the first item presented. From that point any one of a number of branching rules takes over. For example, a correct response may route the testee to a more difficult level; an incorrect response to an easier level. At each level, the examinee is administered the most discriminating item not yet attempted at that level. Under the present strategy, testing terminates when an examinee is responding with only chance success at any level, and he is assigned a score commensurate with the highest level at which he was responding correctly at a rate greater than chance.

Figures 9 and 10 illustrate the progress of two individuals through a 9-level stratified verbal test. The branching strategy is easy to see here, and the difference in test length illustrates one important characteristic of the approach. The first examinee was quite consistent in his performance, and was classified as to level within 14 items. The second examinee, less consistent, took 41 items before being classified. This latter performance, although atypical, points up the flexibility of the method.

So far I have covered the five basic categories of adaptive testing strategies, and mentioned some of the research findings pertinent to them. To do this in the limited space available, much detail was necessarily omitted. A quite thorough review of the literature on adaptive testing has been prepared as a technical report by Weiss and Betz (1973). That document fills in a considerable proportion of the detail missing here, and contains numerous references in addition to those I have cited.

Minnesota Computerized Ability Testing Research

Mentioned earlier was the paucity of empirical research results in the literature of computerized adaptive testing. One empirical research effort, sponsored by the Office of Naval Research, is in progress at the University of Minnesota. The purpose of the research is to investigate the relative utility of adaptive testing versus conventional testing, and to determine the relative merits of various operationalizations of adaptive testing, including the five adaptive strategies discussed.

The work is being conducted using verbal and numerical ability test items administered at CRT (cathode ray tube) terminals to a Control Data Corporation 6400 time-shared computer system. The two different ability dimensions were selected in order to investigate validity generalizability across content areas (a secondary objective of the research project), as well as any differences in psychometric characteristics between multiple-choice (the verbal items) and free-response (the numerical items) formats.

On the basis of preliminary norming studies, traditional item parameters as well as normal ogive model item characteristic curve parameters have been obtained for 605 vocabulary items and 200 number series items. Currently, both linear and adpative tests have been constructed from the vocabulary item pool, while the numerical pool is still being normed and expanded.

	LINEAR	2-STAGE	FLEXILEVEL	PYRAMIDAL	BAYESIAN	STRATIFIED
LINEAR	retest					
2-STAGE	●	retest				
FLEXILEVEL	●	●	retest			
PYRAMIDAL	●	●		retest		
BAYESIAN	●	●	●	●	retest	
STRATIFIED	●		●	●		retest

FIGURE 11: A data collection plan for intercomparisons of six computer-administered testing strategies. Dark circles denote that data have been collected for the comparison indicated. See text for detailed explanation.

The basic design of the adaptive strategy comparisons is illustrated in Figure 11. Each subdiagonal cell represents an intertest correlation; the diagonal entries represent test-retest correlations. At present only one of these correlations is available for reporting, although data have been collected for each comparison whose cell in the figure contains a darkened circle. In two cases, separate data have been obtained for 2 distinct examinee groups: college students and high school students. It is hoped that we shall be able to replicate allthese comparisons in at least two populations differing as to average level of ability.

The diagonal elements of Figure 11 are test-retest stability studies, since temporal stability is an important practical criterion for the evaluation of alternative testing strategies. To date, short-term (approximately 5-week) test-retest stability data are available for each of the testing strategies shown in Figure 11.

Another aspect of the same research involves computer simulation of adaptive testing. Using monte carlo techniques to vary item parameters (difficulty, discrimination) and people parameters (shape of the ability distribution and its range) we hope to find answers to a number of questions relevant to adaptive testing, which at present remain unanswered. Among these are questions regarding the effects on adaptive test characteristics of varying the characteristics of the item pool--numbers of items, range and distribution of item parameters, etc. Another problem to which simulation studies should provide a tentative answer is that of the effects of guessing on the utility of adaptive testing. Derogation of test effectiveness by random guessing may require that more sophisticated testing models be employed. On the other hand, negligible effects due to guessing might effect reduction of the cost of adaptive testing by permitting the use of relatively simple models.

The scoring problem also lends itself to investigation by computer simulation. The variety of scoring schemes available for each of the adaptive procedures is at present a source of some puzzlement. Simulation research should clarify the matter of what scoring techniques are advantageous for each adaptive strategy under specifiable conditions.

I have mentioned only a few of the questions to which simulation studies should provide answers; other such questions undoubtedly will arise in the reader's mind. It is important to remember that the generality of those answers is limited by the assumptions under which the simulations are conducted. Our intention is to generate tentative answers to a number of pertinent questions, then to subject those results to empirical verification.

In keeping with that intention, we have proposed a continuation of the present research, again under ONR sponsorship. In the short run, that proposal includes 1) continued data collection in the college population, in order to complete the inter-strategy comparisons outlined in Figure 11; 2) replication of the present research design in an examinee population differing in central tendency and variability from the college group (this has already been begun, using high school students); and 3) development of improved variations on the basic adaptive strategies discussed in this paper.

In the longer run, we have proposed a large scale validity study, testing several thousand Navy recruits. This research would involve norming the two item pools on samples drawn from the recruit population, followed by real data simulations, using the norming study data to select the most promising adaptive strategies. The best strategies would be employed in live computer-administered testing of recruits, whose graded performance in training and operational settings subsequent to recruit training would serve as the validity criterion.

Concluding Remarks

The stated aim of the symposium included assessment of the state of the art of Occupational Research, with an eye toward the planning of future programs. This paper has proposed computerized adaptive testing as a potential involvement in the measurement of occupationally-related abilities, one which shows promise of more accurate, and potentially more valid, measurement in less time than present group-standardized tests. Substantial gains in the amount of occupationally-relevant information obtainable per unit of time certainly would appear beneficial to decision-makers within the organizations concerned. Gains in the accuracy of ability measurement, especially if achieved by reducing the effects of irrelevant variables on test performance, would appear beneficial to the interests of the individuals concerned. Reports of past research in the area of adaptive testing suggest that both kinds of gains can be expected, given well-constructed tests. Very few such tests exist today. What is called for is a continuing program of theoretical consideration of the potential of computerized adaptive testing, in conjunction with comprehensive empirical investigation of practical problems and practical utility. Such a program, with particular emphasis on empirical aspects, I would suggest to the members of this symposium as an important direction for research and development through the remainder of this decade.

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PROBLEMS AND PROSPECTS IN THE ASSESSMENT OF NONCOGNITIVE TRAITS

P. M. Bentler

An overwhelming emphasis has been placed on the measurement of cognitive or intellective traits in the educational arena, in industry, and in the armed services. The use of intellective measures for assessment, prediction, selection, and classification purposes is coming under ever-increasing attack for a number of reasons. Most obviously, it has become clear at the empirical level that intellective traits--even general intelligence--account for only relatively small proportions of variance in the variety of tasks that confront people in their everyday lives. At the theoretical and empirical levels, in spite of Guilford's (1967) exhaustive and comprehensive three-dimensional system for classifying intellective attributes, our understanding and differential measurement of the variety of cognitive attributes has not proceeded very far. Lack of empirical validity and theoretical understanding, combined with the behavioristic movement in psychology which emphasizes the highly specific nature of most behaviors, calls into question even the ultimate possibility of predicting a variety of behaviors from only a few cognitive constructs. Finally, the Civil Rights Act of 1964 and the later Equal Employment Opportunity Act of 1972 require modification of typical testing practices to become more specific in matching the person to the job, rather than measuring the person in the abstract (Fincher, 1973). The removal of bias to make tests applicable to minority populations has become a major goal, often accompanied by an anti-intelligence testing movement well known to most of you.

The most consistent emphasis on measurement of intellectual competence has probably come from the educational institution. There are signs that even this institution is shifting its orientation to some extent. For example, the conservative College Entrance Examination Board (1970) has suggested that a wider sampling of talents be assessed for college entrance and reported to colleges for revised bases of decision making. There is a consensus that such talents should include real-life relevant variables, such as attitudes, interests, personality and values, and McClelland (1973) has suggested that the following competencies, at the very least, ought to be included in the assessment batteries of testing services: communication skills, patience, moderate goal setting, and ego development. The recent Jencks et al. (1972) report also suggested that non-cognitive attributes may play a larger role than cognitive skills in determining economic success or failure, and suggests that these traits may contribute far more than cognitive skills to the quality of human life and human happiness. Similar movements are being felt in industry and the armed forces, but, as ever, crucial problems remain.

I would like to outline what I consider to be some major, current problems facing researchers and test specialists in this area, and indicate what direction we might move, in order to generate more useful measures.

1. An overview of the literature on non-cognitive trait measurement reveals a distinct absence of agreement regarding either the empirical structure of the domain of non-intellective trait measurement, or even a theoretical consensus regarding the fundamental attributes that require measurement. A perusal of the Seventh Mental Measurements Yearbook (Buros, 1972) indicates how most of the well-known traditional tests in the personality, values, attitudes, and interests domain fall far short in the measurement as well as theoretical sense. Typically, these instruments measure only a few dimensions, or they measure ipsatively, or they require an advanced reading comprehension, or the structure of the instrument is quite unclear. In the personality domain, for example, the Minnesota Multiphasic Personality Inventory, the Edwards Personal Preference Schedule, the Guilford Zimmerman Temperment Survey, the Catell 16-PF, the Edwards Personality Inventory, and others have come under severe attack by a number of workers. For example, the highly elaborate conceptual framework underlying Catell's test has recently been shown to be inadequate in two monumental studies (Sells, Demaree, and Will, 1970; 1971). Although more recent instruments, such as Jackson's Personality Research Form and Comrey's Personality Scales are at least reliable and multidimensional, it still remains true that the constructs assessed by these and other newer measurement instruments are far from universally accepted. There does not exist a consensus regarding the nature of important personality variables. I would hope that the next decade can clarify the nature of underlying attributes, but I am only cautiously optimistic about this prospect. If there is to be consensus, I expect it to grow out of the peer methods of measuring personality, as stemming from the work of Fiske, Tupes and Christal, Borgatta, and Warren Norman (1969). As a result of the work by these persons there seems to be a consensus at the very least regarding the attributes extraversion, agreeableness, dependability, and emotional stability. Unfortunately these broad dispositions have not yet been adequately dissected into components.

2. The measurement of minor variables redundant with previously measured variables, rather than a concentration on major behavioral attributes, continues to be an unfortunate focus of current work. The field is replete with hundreds of measures having little or no implication for important criterion behaviors. Yet, it is becoming clear from work in other areas that significant non-intellective traits do exist and have important predictive validity. For example, Robins (1972) found that school dropout, heroin use, divorce, jail, and alcohol problems were intercorrelated events in a sample of 223 young urban-born and urban-reared black men. Similarly, Roff and Sells (1968) show in a sample of thousands of youngsters, that boys who are rejected by their peers tend to become delinquent on followup. It is unlikely that these events are solely the result of the operation of intellective variables, as some literature might have one believe. Intellective and noncognitive variables can be remarkably interrelated. An important study by Roff, Sells and Golden (1972) demonstrated a consistent difference of about 15 to 20 IQ points between children liked most and children liked least by their peers, in a sample of 2,800 children. While it is, indeed, possible that smarter children become liked more, social learning theory would also predict that children who are liked more become smarter--through the mechanism of greater

positive reinforcement for learning in a school environment. To focus on the intellectual variables alone would surely be a mistake. I would hope that the next decade can be fruitfully used to delineate important behavioral variables in the noncognitive areas of interest to this conference.

3. Lack of multitrait multimethod validity for existing instruments probably remains the major stumbling block in non-cognitive trait measurement. Mischel (1968) reviewed the sad predictive validity of personality measures, and Abelson (1973) similarly summarized the poor predictive performance of attitude measures in predicting significant behavioral events. The more general criticism can be made of all measures in the non-intellective trait area, whether they be values, interests, personality, or attitudes, that the measures possess little in the way of convergent validity, but perhaps equally important, they possess little discriminant validity. Often little more than the three dimensions of semantic space are being measured by personality scales. Not even the recently discovered seven semantic dimensions are assessed (Bentler & Lavoie, 1972a). Although Campbell and Fiske (1959) made clear that any set of multiple measures required at least a partial demonstration of convergent and discriminant validity, it is surprising that a decade-and-a-half after publication of this classic article not a single multivariate test exists that has even published one multitrait multimethod matrix. I do know about one case in which such a matrix existed, but the author did not publish the entire matrix. Instead he simply listed the part of the matrix--the convergent validities--that was flattering to his test. I would hope that the next decade yields at least a few instances of Campbell-Fiske validation. Ideally, of course, such attempts would demonstrate the successful measurement of important constructs; but I would even be encouraged by the publication of unsuccessful validational attempts in this area. I suspect that very little progress will be made toward developing measures of important non-cognitive traits until method-free instruments or techniques of validation are developed. I think a reliance on self-report statements alone, as is all too typically done, is a foolhardy procedure. I have been devoting a substantial portion of my time to developing 28 trait measures possessing peer-self validities, with a surprising amount of success.

4. Perhaps the largest class of non-cognitive trait measures are self-report in nature--and self-report is fakeable. The fourth major problem I see lies in the lack of availability of maximum performance measures. These would be relatively unfakeable. As Wallace (1966), McClelland (1973) and others have emphasized, it is important to devise measures in which the subject is made aware of the attribute being measured, and is asked to maximize his performance. Such procedures are standardly used in simulation tests as well as in intelligence tests. Implementing maximum performance measurement will require the development of behavioral tests demonstrating the requisite validities. I would hope in the next decade we start to work on these tasks. I suspect that the major impetus for this work will come from the necessity of devising job-sampled instruments which typically serve as criteria rather than predictor variables.

5. It is well known that inadequate measures exist for minority group members. This fifth problem requires, at the very least, obtaining norms, reliabilities, and validities that have relevance to special, but important and previously unmeasured, target pupulations. For example, women are surely going to enter nontraditional occupations. Not only is the surmounting of this problem an ethical requirement for those who work in the field, but it has become a legal requirement as well. The courts will no longer accept irrelevant measures. In the long run, this means that tests will have to be devised with these special populations in mind. Perhaps new testing formats will have to be devised, such as my own non-verbal semantic differential (Bentler & LaVoie, 1972b). It will provide a challenging task to devise assessment procedures that do not yield a double standard or bias when applied in practice. Yet, devising such measures is a legally required task for the future.

6. It is quite appropriate that an institution aim to maximize its objectives, and in the past there has been a major emphasis on the utility of testing for institutional purposes (Wiggins, 1973). I think this emphasis represents the sixth problem, since as the culture changes to value diversity and individual growth, we will have to adopt a strategy that not only maximizes institutional utility, but maximizes the utility of testing for an individual as well. Tests must generate consequences helpful to an individual's long-range goals as well as decisions assisting the functioning of an ongoing institution. The law has at least recognized that testing cannot unfairly harm an individual, by being biased against him without legitimate grounds, but I suspect that the law will not provide the necessary emphasis towards the growth of the individual. However, I do believe that as large institutions recognize their role in fostering individual creativity, growth and adaptation, the trend toward assistance in such growth will continue.

7. It is not hard to explain how large institutions in times of an expanding population have relied heavily on tests to assist their selection of candidates. Selection of volunteers for the armed services represents one such example. While selection will continue to be an important focus of testing practices, the nature of selection will have to change, and classification will become more relevant. This is the seventh problem area. As mentioned several times, selection procedures will have to be based upon demonstrated validity, or else the law will refuse to recognize their acceptability. This legal requirement will put great strain on the development of effective criterion measures, since most predictors are not much better than the criteria they can hope to be related to. But the selection process will, in my estimation, give way to a greater emphasis on classifying existing individuals into multiple positions of optimal benefit both to the individual and institution. If there are deficiencies in an individual's qualification for a particular job, I suspect that training programs will aim to modify these. Training will replace selection. The selection ratio will also no doubt change, and as the pressures converge on institutions to accept most anyone, classification procedures that match people and appropriate job categories--being of benefit both to the institution and the individual--will become of greater value.

8. A problem closely related to implementing useful classification procedures lies in the development of a reliable and replicable methodology for classifying people (Rulon, Tiedeman, Tatsuska, Langmuir, 1967). Trait psychology has generated such avid adherents that the typologists have been relegated to the wayside. Only recently are tools for generating typologies involving clustering procedures being seriously investigated, and the hypothesis of multivariate normal distributions of traits is slowly being subjected to more careful scrutiny. The success of training programs, experimental manipulations, and the like surely hinge on the nature of the people being included. I suspect that the problem of developing typologies of people will be taken more seriously in the next decade, particularly as better measures of socially significant variables become available.

9. Implicit in most of my previously identified problems lies a series of methodological, psychometric, and statistical problems that require solution. Thus, the ninth problem area involves the lack of adequate analytic techniques to be used in generating meaningful analyses for the content problems of interest to us. In spite of the progress made in the development of multivariate methods over the past decade, numerous problems remain. For example, clustering techniques that for the first time are being seriously investigated, still require too many subjective decisions in their use. Although factor analytic methods have become more sophisticated recently in the development of scale-free methodologies, restricted factor solutions, and target rotation procedures, nonetheless they cannot yet cope with the old problem of Heywood cases, Gramain residual matrices, the measurement of mean change, and analysis of very large matrices such as 600 variable, 30 factor problems. The linear model is unduly restrictive, particularly in the typical binary data case. More general models, such as those involving monotonic relationships rather than linear relations, deserve further study and development. Some of my own work has recently been directed to these areas (Bentler, 1970, 1972a, 1972b, 1973). Multivariate analysis of variance methodologies also require implementation and distribution. And of course there are numerous important developments that have potential bearing on this area, such as the work on path analysis, generalizability theory, functional measurement, etcetera. I suspect these technical difficulties can be solved more easily than the conceptual problems more particular to personality assessment as a science.

10. Finally, the tenth problem that I see lies in the confrontation between the increasing demands made upon institutions for generating optimal decisions in this area, while these institutions are at the same time faced with declining research funds to enable them to generate solutions and study various alternative procedures for solving these problems. For this contradiction, I have no long-range prediction. I can only hope that things get better again.

I might say a few concluding words highly specific to a project in non-cognitive trait measurement that I understand is being conducted for the Navy. I am not entirely optimistic about the eventual success of that enterprise. The problems involved are too many; and I am not convinced that adequate precautions have been taken to meet some of the general criticisms of work in this area such as I have presented above. As I understand it, the test items are very traditional single-stimulus true false response type, likely to yield strong method factors; the wording is lengthy and not appropriate for poor readers, so that auditory presentation formats become necessary; the techniques of scale construction represent inappropriate linear factor models using blind rotation procedures; analyses are based on partial data; and a one-shot scale construction strategy is emphasized. Although experts in the field have framed the overall approach, I cannot be optimistic about the product of such procedures, given the results that other workers have achieved using similar approaches.

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Commanding Officer, Naval Training Equipment Center
Commanding Officer, Naval Education and Training Support Center, Pacific
Commanding Officer, Navy Medical Neuropsychiatric Research Unit
Commanding Officer, Naval Aerospace Medical Institute
Commanding Officer, Naval Submarine Medical Center
Commanding Officer, Naval Medical Research Institute
Superintendent, Naval Academy
Superintendent, Naval Postgraduate School
Superintendent, United States Military Academy
Superintendent, Air Force Academy
Superintendent, Coast Guard Academy
Chief of Research and Development, U. S. Army
Army Research Institute for Behavioral and Social Sciences
Personnel Research Division, Lackland Air Force Base
Air Force Human Resources Laboratory, Brooks Air Force Base
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